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AUTHOR Barron, Marcelline A.
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ABSTRACT

This document contains the listings for 46 computer programs which are designed to teach various concepts in chemistry and physics. Significant time was spent in writing programs in which students would input chemical and physical data from their laboratory experiments. No significant time was spent writing drill and practice programs other than assistance programs in unit conversions. The programs were written in BASIC language on an Apple II+ microcomputer with a language card, but they will rerun on Apple IIe and IIc microcomputers as well. Topic areas of the programs include: clock; cloud chamber; coefficient of friction; Coulomb's law; density; E field; enthalpy; gas; half life; ideal gas law; inclined plane; molar relationships; two-dimensional collisions; metric conversion; Ohm's law; pendulums; projectile motion; refraction; relativity; vector addition; velocity; waves; and others. These programs are offered as a beginning upon which users can build and modify. Several programs call for B-files (particularly those involving graphics). Since these files are written in machine code, they are not listed in this document. Users can create their own graphics or can send blank disks to obtain copies of the B files. (JN)

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CATS -- COMPUTER ASSISTED TEACHING IN SCIENCE

BY

DR. MARCELLINE A. BARRON

MAY, 1986

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SE 046 561

CATS -- Computer Assisted Teaching in Science

In the early 1980's teachers who wanted to use microcomputers in their classrooms found almost no software available to them. Therefore, teachers used the computer to teach themselves how to write the software they needed. At Western Hills High School, Cincinnati Public Schools, in the chemistry and physics classroom/laboratory with an Apple II+, single disk drive, language card and monitor, Dr. Marcelline Barron and her students created the programs they needed.. Dr. Barron trained a group of twelve student programmers who worked with her in writing simulations to teach various concepts in chemistry and physics. Also considerable time was spent in writing program into which her students would input chemical and physical data from their laboratory experiments. No significant time was spent writing drill and practice programs other than assistance programs in unit conversions.

The computer programs which follow are a result of three years (1980-1983) of work with the science students at Western Hills High School by Dr. Barron. The programs were written in BASIC language on an Apple II+ computer with a language card but they will run on Apple IIe and IIc computers as well. The student programmer names for the most part are indicated within the REM statements of each program. Dr. Roger Burgess of the Cincinnati Public Schools also participated in the project in the early years and some of the programs mention him as well. Also Dr. John Novak was in-

volved in the final publishing of this document. The authors of these programs offer them to the user as a beginning upon which the user can build and modify. A special note should be made that some of the programs call up loading B Files. Since these files are written in machine code it is not possible for them to be listed here. The user could create their own graphics that would be appropriate at that point. If this is not easy to do, please send some blank disks to the address below and a copy of the B Files will be forwarded to the requestor.

Dr. Marcelline A. Barron
Cincinnati Public Schools
230 E. 9th St.
Cincinnati, OH 45202

TITLES OF PROGRAMS LISTED IN THIS DOCUMENT

BASIC COMCARD

CLOCK

CLOUD CHAMBER

COEFFICIENT OF FRICTION

COLOR SCREEN

COLORS/V

COULOMB'S LAW

DECWRITER/DRIVER

DENSITY

EFFICIENCY

E FIELD

ELECTRICAL EQUIVALENT

EMISSION SPECTRUM

ENTHALPY

GAS

GAS/GRAF

GAS/GRAF2

GRAMS/MOLES

HALF LIFE

HELLO

HELLO-1

HELLO-*

HGR

IDEAL GAS LAW

INCLINED PLANE

TITLES OF PROGRAMS LISTED IN THIS DOCUMENT CONT'D

INVENTORY

LENSMIR

MARBLES;2D COLLISIONS

METRIC CONVERSION

MOLAR RELATIONSHIPS

OHM S LAW

PENDULUMS

PERCENT ERROR

PERSFILE

PLOT-1

PROJECTILE MOTION

PROLOGUE SYS.

REFRACTION

RELATIVITY

ROTATIONAL INERTIA EQ/CALC.

TEMPERATURE CONVERSIONS

TIMER

VECTOR ADDITION

VELOCITY

WAVES

BASIC COMCARD

Basic comcard is the comcard routine translated from machine language to "BASIC" to drive a printer which needs a line feed signal. It commands the machine to advance the paper. Also it changes the character output of the Apple from 40 characters to user defined numbers, up to 132.

```
 10  REM  APPLE BASIC PROGRAM LIBRARY
 20  REM
 30  REM  NAME:  BASIC COMCARD
 40  REM  FOR USE WITH A PRINTER THAT NEEDS A LINE FEED CHARACTER
 50  REM  REVISED FOR  DOS 3.3
 60  REM  BY:   TROY OWENS
 70  REM
 80  REM  THE COMMANDS FOR USING THIS
 90  REM  PROGRAM ARE
100  REM
110  REM    POKE,X
120  REM   WHERE X IS THE NUMBER OF HORIZONTAL COLUMNS WANTED
130  REM   POKE 36,T
140  REM  WHERE T IS THE NUMBER OF COLUMNS YOU WISH TO TAB
150  REM   POKE 768,S
160  REM  IF YOUR CARD IS NOT IN SLOT#2   S=SLOT NUMBER OF CARD
170  FOR X = 768 TO 949
180      READ Y
190      POKE X,Y
200  NEXT X
210  CALL 775
220  IN# 2
230  STOP
240  DATA 2,40,8,5,194,24,176,56,152,72
250  DATA 172,0,3,8,169,5,141,3,3,169,192
260  DATA 24,109,0,3,141,4,3,169,255,153
270  DATA 120,7,169,17,153,248,7,152,10
280  DATA 10,10,10,168,169,3,153,142,192
290  DATA 169,17,153,142,192,169,40,141,1,3
300  DATA 169,54,133,42,160,0,140,2,3,132
310  DATA 43,40,144,14,173,231,3,233,110
320  DATA 133,42,173,232,3,233,0,133,43
330  DATA 169,99,145,42,200,169,3,145,42
340  DATA 104,168,96,72,72,173,2,3,197
350  DATA 36,104,176,3,72,169,160,44,98
360  DATA 3,240,3,238,2,3,8,32,169,3,40
370  DATA 104,72,144,228,73,13,10,208
380  DATA 13,141,2,3,169,138,32,169,3
390  DATA 169,88,32,168,252,169,0,133
400  DATA 36,173,2,3,240,9,237,1,3,233
410  DATA 247,144,4,105,31,133,36,104
420  DATA 96,108,3,3,0,0,0,255,255,255
430  DATA 255,255,255,255
     END OF LISTING

     PROGRAM LENGTH: 43 LINES / 1215 BYTES
```

CLOCK

This program is a digital clock which sets the time at your choice.

Input: number of hours, number of minutes, and number of seconds

Results: The program then begins the clock, counting forward from the input values given.

```
 10  HOME
 20  PRINT  TAB( 14)"DIGITAL CLOCK"
 69  VTAB 24
 70  INPUT "PRESS <RETURN> TO START ====>";A$
120  LET X = 0:
     LET Y = 0:
     LET Z = 0
125  GOSUB 499
130  HOME
140  PRINT  TAB( 14)"DIGITAL CLOCK"
150  VTAB 12
160  PRINT  TAB( 9)"HRS ";Z;" : MIN ";Y;" : SEC ";X
170  GOSUB 250
180  LET X = X + 1
190  IF X = 60 THEN
         210
200  GOTO 150
210  LET X = 0
220  LET Y = Y + 1
230  IF Y = 60 THEN
         280
240  GOTO 130
250  FOR A = 1 TO 700
260  NEXT A
270  RETURN
280  LET Y = 0
290  LET Z = Z + 1
300  IF Z = 13 THEN
        LET Z = 1
310  GOTO 130
499  HOME
500  INVERSE :
     HTAB 16:
     PRINT "SET TIME":
     NORMAL
510  VTAB 5:
     INPUT "HOUR?";Z
520  INPUT "MINUTES?";Y
530  INPUT "SECONDS?";X
535  VTAB 12:
     HTAB 4
```

```
540  PRINT " HOURS ";Z;":MINUTES";Y;":SECONDS";X
550  VTAB 20:
     INPUT "ARE THEY CORRECT?";Q$
560  IF  LEFT$ (Q$,1) = "Y" THEN
         RETURN
570  IF  LEFT$ (Q$,1) = "N" THEN
         499
580  GOTO 550


END OF LISTING

PROGRAM LENGTH: 36 LINES / 554 BYTES
```

CLOUD CHAMBER

Cloud Chamber is a program which has two major components: general information about the cloud chamber as an experimental instrument and a graphic simulation of the results obtained when an alpha source or a beta source is placed in the chamber. In addition the simulation also displays the results of just allowing cosmic radiation to penetrate the cloud chamber environment. This is an extremely difficult experiment to manage in a typical physics or chemistry laboratory due to constraints on equipment, dry ice, etc.

Data Input

Choice of alpha, beta, or cosmic display

Results Returned

A graphics display of particle (alpha, beta, or cosmic) tracking

```
10  REM  ************************
15  REM                          *
20  REM       CLOUD  CHAMBER     *
25  REM         SIMULATION       *
30  REM              BY          *
35  REM       TROY S. OWENS      *
40  REM  DR. MARCELLINE BARRON   *
45  REM         (C) - 1981       *
50  REM                          *
55  REM  ************************
60  HOME :
    HGR :
    TEXT :
    HOME
65  VTAB 10:
    HTAB 10:
    PRINT "ONE MOMENT PLEASE ... ";
70  PRINT
75  REM  POKE -16303,0 = OFF
80  REM  POKE -16304,0 = ON
85  PRINT  CHR$ (4);"BLOAD CLOUD GRFX"
90  IF M = 1 THEN
```

```
        220
 95  SPEED= 100
100  HOME
105  VTAB 9
110  HTAB 13
115  PRINT "C";:
     GOSUB 205:
     PRINT "L";:
     GOSUB 205:
     PRINT "O";:
     GOSUB 205:
     PRINT "U";:
     GOSUB 205:
     PRINT "D";:
     GOSUB 205:
     PRINT " ";:
     GOSUB 205
120  PRINT " ";:
     GOSUB 205
125  PRINT "C";:
     GOSUB 205:
     PRINT "H";:
     GOSUB 205:
     PRINT "A";:
     GOSUB 205:
     PRINT "M";:
     GOSUB 205:
     PRINT "B";:
     GOSUB 205:
     PRINT "E";:
     GOSUB 205:
     PRINT "R":
     GOSUB 205
130  HTAB 15
135  PRINT "S";:
     GOSUB 205:
     PRINT "I";:
     GOSUB 205:
     PRINT "M";:
     GOSUB 205:
     PRINT "U";:
     GOSUB 205:
     PRINT "L";:
     GOSUB 205:
     PRINT "A";:
     GOSUB 205:
     PRINT "T";:
     GOSUB 205:
     PRINT "I";:
     GOSUB 205:
     PRINT "O";:
     GOSUB 205:
     PRINT "N";:
     GOSUB 205
```

```
140  PRINT
145  PRINT :
     HTAB 19:
     PRINT "B";:
     GOSUB 205:
     PRINT "Y":
     GOSUB 205
150  PRINT :
     HTAB 13
155  PRINT "T";:
     GOSUB 205:
     PRINT "R";:
     GOSUB 205:
     PRINT "O";:
     GOSUB 205:
     PRINT "Y";:
     GOSUB 205
160  PRINT " ";:
     GOSUB 205:
     PRINT "S";:
     GOSUB 205:
     PRINT ".";:
     GOSUB 205
165  PRINT " ";:
     GOSUB 205
170  PRINT "O";:
     GOSUB 205:
     PRINT "W";:
     GOSUB 205:
     PRINT "E";:
     GOSUB 205:
     PRINT "N";:
     GOSUB 205:
     PRINT "S";:
     GOSUB 205:
     PRINT " ";:
     GOSUB 205
175  PRINT :
     HTAB 3
180  PRINT "D";:
     GOSUB 205:
     PRINT "R";:
     GOSUB 205:
     PRINT ".";:
     GOSUB 205:
     PRINT " ";:
     GOSUB 205:
     PRINT "M";:
     GOSUB 205:
     PRINT "A";:
```

```
      GOSUB 205:
      PRINT "R";:
      GOSUB 205:
      PRINT "C";:
      GOSUB 205:
      PRINT "E";:
      GOSUB 205
185   PRINT "L";:
      GOSUB 205:
      PRINT "L";:
      GOSUB 205:
      PRINT "I";:
      GOSUB 205:
      PRINT "N";:
      GOSUB 205:
      PRINT "E";:
      GOSUB 205
190   PRINT " ";:
      GOSUB 205:
      PRINT "B";:
      GOSUB 205:
      PRINT "A";:
      GOSUB 205:
      PRINT "R";:
      GOSUB 205:
      PRINT "R";:
      GOSUB 205:
      PRINT "O";:
      GOSUB 205:
      PRINT "N";:
      GOSUB 205
195   PRINT " ";:
      GOSUB 205:
      PRINT "(";:
      GOSUB 205:
      PRINT "C";:
      GOSUB 205:
      PRINT ")";:
      GOSUB 205:
      PRINT " ";:
      GOSUB 205:
      PRINT "-";:
      GOSUB 205:
      PRINT " ";:
      GOSUB 205:
      PRINT "1";:
      GOSUB 205:
      PRINT "9";:
      GOSUB 205:
      PRINT "8";:
      GOSUB 205:
      PRINT "2"
```

```
200  GOTO 210
205  LET O =  PEEK ( - 16336):
     LET O =  PEEK ( - 16336):
     LET O =  PEEK ( - 16336):
     RETURN
210  SPEED= 255
215  FOR X = 1 TO 6000:
     NEXT
220  HOME
225  POKE  - 16303,0
230  VTAB 5:
     PRINT "OPTIONS:":
     PRINT "--------"
235  PRINT :
     PRINT :
     HTAB 6
240  PRINT "1.  ALPHA  PARTICLE SIMULATION"
245  PRINT :
     HTAB 6:
     PRINT "2.  BETA   PARTICLE SIMULATION"
250  PRINT :
     HTAB 6:
     PRINT "3.  COSMIC PARTICLE SIMULATION"
255  PRINT :
     HTAB 6:
     PRINT "4.  INFORMATION"
260  PRINT :
     HTAB 6:
     PRINT "5.  END PROGRAM"
265  VTAB 20
270  PRINT :
     PRINT "ENTER CHOICE => ";:
     GET B$
275  LET B =  VAL (B$):
     LET B =  INT (B):
     IF B < 1 OR B > 5 THEN
        220
280  ON B GOTO 290,575,705,850,285
285  HOME :
     END
290  REM  ** ALPHA PARTICLE **
295  CLEAR
300  LET S$ = "ALPHA"
305  HOME :
     VTAB 20:
     POKE  - 16304,0
310  LET C = 0:
     LET L1 = 178:
     LET L2 = 185:
     LET H1 = 29:
     LET H2 = 35:
     HCOLOR= C:
     GOSUB 315:
     GOTO 325
```

```
315  FOR P = L1 TO L2:
         HPLOT P,H1 TO P,H2:
     NEXT
320  RETURN
325  LET C = 3:
     HCOLOR= C
330  FOR TIME =  INT (1000 * ( RND (1))) TO 900
335  NEXT TIME
340  GOSUB 410
345  GOSUB 315
350  IF D > 60 GOTO 470
355  IF I > 10 THEN
         LET I = 0:
         LET C = 3 - C:
         HCOLOR= C
360  HCOLOR= C
365  HPLOT 90,52 TO X,Y
370  LET I = I + 1:
     LET D = D + 1
375  HCOLOR= Q
380  IF Q1 = 1 THEN
         GOSUB 515:
         GOTO 405
385  IF Q1 = 2 THEN
         GOSUB 520:
         GOTO 405
390  IF Q1 = 3 THEN
         GOSUB 525:
         GOTO 405
395  IF Q1 = 4 THEN
         GOSUB 530:
         GOTO 405
400  IF Q1 = 5 THEN
         GOSUB 535:
         GOTO 405
405  GOTO 330
410  LET X =  INT (1000 * ( RND (1))) / 5
415  IF X < 50 OR X > 130 THEN
         410
420  LET Y =  INT (1000 * ( RND (1))) / 5
425  IF Y < 55 OR Y > 100 THEN
         420
430  LET F =  INT (16 * ( RND (1))) / 4
435  LET S =  INT (1000 *  RND (1)) / 3.5
440  IF S < 200 OR S > 253 THEN
         435
445  LET U =  INT (1000 *  RND (1)) / 3.5
450  IF U < 107 OR U > 129 THEN
         445
455  LET Q = 3 - Q
460  LET Q1 = Q1 + 1:
     IF Q1 > 5 THEN
         LET Q1 = 1
```

```
465  RETURN
470  HCOLOR= 0
475  FOR X = 50 TO 132
480       IF A =  > 5 GOTO 490
485       ON A GOSUB 515,520,525,530,535
490       HPLOT X,52 TO X,100
495       LET A = A + 1
500  NEXT :
     HPLOT 248,118 TO 210,118:
     LET D = 0:
     LET C = 3:
     LET Q = 3:
     LET A = 0
505  HCOLOR= 0:
     GOSUB 315
510  GOSUB 540:
     GOTO 560
515  HPLOT 248,118 TO 210,110:
     RETURN
520  HPLOT 248,118 TO 230,125:
     RETURN
525  HPLOT 248,118 TO 235,109:
     RETURN
530  HPLOT 248,118 TO 215,128:
     RETURN
535  HPLOT 248,118 TO 210,118:
     RETURN
540  VTAB 22
545  HCOLOR= 3:
     GOSUB 315
550  PRINT "PRESS ' SPACE BAR '  TO CONTINUE --- ":
     PRINT "PRESS ' R ' TO REPEAT SIMULATION --- ";:
     GET T$
555  RETURN
560  IF T$ = "R" THEN
          290
565  IF T$ = " " THEN
          220
570  GOTO 510
575  REM  *** BETA PARTICLES ***
580  CLEAR
585  HOME
590  POKE  - 16304,0
595  LET L1 = 178:
     LET L2 = 185:
     LET H1 = 44:
     LET H2 = 50
600  HCOLOR= C
605  GOSUB 315
610  GOSUB 410
615  LET F =  INT (30 *  RND (1) / 5)
620  IF F < 1 THEN
          LET F = 1
```

```
625  IF F > 5 THEN
         LET F = 5
630  HCOLOR= 3
635  HPLOT 90,52 TO X,Y
640  ON F GOSUB 515,520,525,530,535
645  LET T =  INT (1000 *  RND (1))
650  FOR D = 1 TO 500:
     NEXT
655  HCOLOR= 0:
     HPLOT 90,52 TO X,Y
660  ON F GOSUB 515,520,525,530,535
665  FOR D = 1 TO T:
     NEXT
670  LET I = I + 1
675  IF I > 55 THEN
         685
680  LET C = 3 - C:
     GOTO 600
685  VTAB 23:
     PRINT "PRESS ' SPACE BAR '  TO CONTINUE --- "
690  PRINT "PRESS ' R ' TO REPEAT SIMULATION --- ";:
     GET T$
695  IF T$ = "R" THEN
         575
700  POKE  - 16303,0:
     GOTO 220
705  REM  *** COSMIC PARTICLES ***
710  CLEAR
715  HOME
720  POKE  - 16304,0
725  LET L1 = 178:
     LET L2 = 185:
     LET H1 = 59:
     LET H2 = 65:
     HCOLOR= 0:
     GOSUB 315
730  FOR X = 85 TO 100:
         HPLOT X,32 TO X,60:
     NEXT
735  FOR X = 248 TO 257:
         HPLOT X,118:
     NEXT
740  HCOLOR= 3
745  GOSUB 410
750  IF I > 28 THEN
         815
755  LET A = X:
     LET B = Y:
     LET V = U:
     LET W = S:
     GOSUB 410
```

```
760  GOSUB 315
765  HPLOT A,B TO X,Y
770  HPLOT S,U TO W,V
775  FOR D = 1 TO 500:
     NEXT
780  HCOLOR= 0
785  HPLOT A,B TO X,Y
790  HPLOT S,U TO W,V
795  GOSUB 315
800  HCOLOR= 3
805  LET I = I + 1
810  GOTO 740
815  VTAB 23:
     PRINT "PRESS ' SPACE BAR '  TO CONTINUE --- "
820  PRINT "PRESS ' R ' TO REPEAT SIMULATION ---";:
     GET T$
825  IF T$ = "R" THEN
         705
830  HOME :
     POKE  - 16303,0
835  HGR :
     TEXT :
     HOME
840  VTAB 12:
     HTAB 9:
     PRINT "ONE MOMENT PLEASE ...":
     PRINT  CHR$ (4);"BLOAD CLOUD GRFX"
845  GOTO 220
850  REM  *** INFORMATION ***
855  HOME
860  VTAB 2:
     HTAB 8:
     INVERSE :
     PRINT "CLOUD CHAMBER INFORMATION"
865  NORMAL :
     VTAB 5
870  PRINT "A CLOUD CHAMBER IS A CHAMBER IN WHICH   THE HUMIDITY IS SO HIGH
      THAT THE VAPOR  ALMOST CONDENSES."
875  VTAB 10
880  PRINT "IN A CLOUD CHAMBER, A SUBSTANCE LIKE    ALCOHOL CONDENSES FROM
     A GAS TO A       LIQUID TO MAKE NUCLEAR EVENTS VISIBLE."
885  VTAB 15
890  PRINT "JUST ABOVE THE FLOOR OF THE CHAMBER     THERE IS A REGION WHERE
      THE ALCOHOL     VAPOR DOES NOT CONDENSE UNLESS THERE    ARE SEEDS ARO
     UND WHICH THE ALCOHOL      DROPS CAN FORM."
895  VTAB 23
900  PRINT "PRESS ANY KEY TO CONTINUE ";:
     GET T$
905  HOME
```

```
910  VTAB 2:
     HTAB 8:
     INVERSE :
     PRINT "CLOUD CHAMBER INFORMATION":
     NORMAL :
     VTAB 5
915  PRINT "IF A POSITIVE ION SUCH AS AN ALPHA      PARTICLE HAPPENS TO BE
     PASSING THROUGH  THE CHAMBER, IT LEAVES A TRAIL OF IONS  BEHIND IT."
920  VTAB 11
925  PRINT "DROPLETS FORMING ON THESE IONS MARK     THE PATH OF THE PARTICL
     E WHICH CAN      THEN BE SEEN AND PHOTOGRAPHED."
930  VTAB 16
935  PRINT "IN MOST LABORATORY SITUATIONS TH CLOUD"
940  PRINT "CHAMBER IS COOLED BY USING DRY ICE."
945  PRINT "THE CHAMBER ITSELF IS SET ON A BLOCK"
950  PRINT "OF DRY ICE ALLOWONG THE VAPOR TO "
955  PRINT "BECOME SUPERCOOLED PRODUCING A CLOUD."
960  VTAB 23
965  PRINT "PRESS ANY KEY TO CONTINUE ";:
     GET T$
970  GOTO 220


 END OF LISTING

 PROGRAM LENGTH: 193 LINES / 5004 BYTES
```

COEFFICIENT OF FRICTION

The program coefficient of friction is one directly usable by students after having done the appropriate experiment.

The data called for is: a. weight vector

b. angle (in degrees)

The program will then compute in newtons and print out:

a. the motion vector

b. the force normal

c. the friction force and

d. the coefficient of friction for the experiment

```
   5  TEXT :
      HOME
  10  VTAB 6:
      HTAB 8:
      PRINT "COEFFICIENT OF FRICTION"
  15  VTAB 8:
      HTAB 15:
      PRINT "WRITTEN BY"
  20  VTAB 11:
      HTAB 13:
      PRINT "SPENCER MORGAN"
  25  VTAB 13:
      HTAB 9:
      PRINT "DR. MARCELLINE BARRON"
  30  VTAB 15:
      HTAB 12:
      PRINT "DENNIS CALDWELL"
  35  GOSUB 3010
 100  REM  BY SPENCER MORGAN
 110  REM  REVISED 11-10-82
 210  REM     BY D.C.
 310  TEXT :
      HOME
 410  VTAB 5:
      HTAB 3
 510  INPUT "WHAT IS THE WEIGHT VECTOR ? ";FW
 610  PRINT :
      PRINT
 710  INPUT "WHAT IS THE ANGLE IN DEGREES ? ";A
 810  LET B = A / 57.3
 910  LET FP = ( SIN (B)) * FW
1010  LET F1 = ( COS (B)) * FW
1110  LET FF = FP
1210  LET M = FF / F1
```

```
1310  GOSUB 2210
1410  GOSUB 3010
1510  PRINT :
      PRINT :
      PRINT :
      HTAB 5:
      VTAB 5:
      PRINT "FW = "FW" NEWTONS"
1610  PRINT :
      HTAB 5:
      PRINT "AN = "A" DEGREES"
1710  PRINT :
      HTAB 5:
      PRINT "FP = "FP" NEWTONS"
1810  PRINT :
      HTAB 5:
      PRINT "FN = "F1" NEWTONS"
1910  PRINT :
      HTAB 5:
      PRINT "FF = "FF" NEWTONS"
2010  PRINT :
      HTAB 5:
      PRINT "M  = "M

2110  GOSUB 3610
2210  HOME
2310  VTAB 5:
      HTAB 5:
      PRINT "FW = THE WEIGHT"
2410  PRINT :
      HTAB 5:
      PRINT "AN = THE ANGLE"
2510  PRINT :
      HTAB 5:
      PRINT "FP = THE MOTION VECTOR"
2610  PRINT :
      HTAB 5:
      PRINT "FN = THE FORCE NORMAL"
2710  PRINT :
      HTAB 5:
      PRINT "FF = THE FRICTION FORCE"
2810  PRINT :
      HTAB 5:
      PRINT "M  = COEFFICIENT OF FRICTION"
2910  RETURN
3010  VTAB 24:
      HTAB 10:
      PRINT "PRESS ANY KEY TO CONTINUE"
3110  LET Q =  PEEK ( - 16384)
3210  IF Q > 127 THEN
          3410
3310  GOTO 3110
3410  POKE  - 16368,0
```

```
3510  HOME :
      RETURN
3610  PRINT :
      PRINT :
      PRINT "TO RUN AGIAN PRESS 'R'"
3710  PRINT "TO EXIT PRESS 'Q'"
3810  GET K$
3910  IF K$ = "R" THEN
          310
4010  IF K$ <  > "Q" THEN
          3810
```

END OF LISTING

PROGRAM LENGTH: 48 LINES / 1042 BYTES

COLOR SCREEN

This program displays the entire graphics screen in all 16 colors sequentially so that the programmer can see what the various background colors will look like when choosing one in creating a graphics display.

```
10  GR
15  HOME
20  FOR A = 15 TO 0 STEP  - 1
30      FOR X = 1 TO 39
35          FOR D = 1 TO 39
40              COLOR= A
50              PLOT D,X
55          NEXT D
60      NEXT X
70  NEXT A
80  PRINT "THAT IS ALL.  GOODBYE!"
```

```
END OF LISTING

PROGRAM LENGTH: 11 LINES / 119 BYTES
```

COLORS/V

This program displays the various colors available in the graphics mode in vertical bars. The colors run from 0 to 15.

```
10  GR
15  HOME
20  FOR A = 0 TO 15
30      FOR X = 1 TO 39
40          COLOR= A
50          PLOT A,X
60      NEXT X
70  NEXT A
80  PRINT "COLOR BARS AVAILABLE IN GRAPHICS"
```

END OF LISTING

PROGRAM LENGTH: 9 LINES / 107 BYTES

COULOMB'S LAW

This program plots the standard curve for Coulomb's Law. It is an incomplete program since the next step is to have students input their data points on this curve, compare, and calculate percent error.

```
 10  TEXT :
     HOME
 15  GOSUB 290
 20  DIM A$(100)
 30  GR
 40  GOSUB 160
 50  COLOR= 6
 60  HLIN 0,39 AT 39
 70  VLIN 0,39 AT 0
 80  LET X = 1
 90  LET R = 1 / X ^ 2
100  LET Y = 39 - (R * 39)
110  COLOR= A
120  PLOT X,Y
130  LET X = X + 1
140  IF X > 39 THEN
         200
150  GOTO 90
160  HOME
170  PRINT "PLEASE PICK A COLOR (1-15)"
180  GET A
190  RETURN
200  HOME
210  PRINT "AGAIN  (Y/N)?"
220  INPUT A$
230  IF A$ = "Y" THEN
         GOTO 30
240  TEXT :
     HOME
250  PRINT "GOODBYE"
260  END
290  HOME :
     PRINT "COULOMB'S LAW"
300  PRINT :
     PRINT :
     PRINT :
     PRINT
305  PRINT "ELECTRIC FORCES ARE IMPORTANT IN        HOLDING TOGETHER THE PA
     RTICLES THAT     MAKE UP ATOMS AND IN HOLDING ATOMS      TOGETHER."
310  PRINT :
     PRINT :
     PRINT
315  PRINT "THE BEHAVIOR OF ELECTRIC FORCES IS THE  KEY TO UNDERSTANDING AT
     OMIC STRUCTURES."
```

```
320  PRINT :
     PRINT :
     PRINT
325  PRINT "PRESS (RETURN) TO CONTINUE.":
     GET Z$
326  HOME
327  PRINT "COULOMB'S LAW STATES THAT THE FORCE     BETWEEN TWO CHARGED BOD
     IES VARIES       DIRECTLY WITH THE PRODUCT OF THEIR      CHARGES AND I
     NVERSELY WITH THE SQUARE   OF THE DISTANCE BETWEEN THEM."
328  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
329  PRINT "EXPRESSED AS A EQUATION COULOMB'S LAW   LOOKS LIKE THIS:
                                                                    F=
     K*Q(1)*Q(2)/R^2
330  PRINT :
     PRINT :
     PRINT
335  PRINT "K IS THE PROPORTIONALITY FACTOR!"
337  PRINT :
     PRINT
340  PRINT "PRESS (RETURN) TO CONTINUE":
     GET X$
350  HOME
360  PRINT "THE CHARGES ON THE BODIES, Q(1) &Q(2)   ARE SEPARATED BY A DIST
     ANCE R."
370  PRINT :
     PRINT :
     PRINT :
     PRINT
380  PRINT "YOU SHOULD NOTE THAT THIS EQUATION      IS SIMILAR TO THE ONE F
     OR GRAVITATIONAL FORCE WHICH NEWTON DESCRIBED."
390  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
400  PRINT "PRESS (RETURN) TO CONTINUE":
     GET T$
410  HOME
415  PRINT "   **********************"
416  PRINT
417  PRINT "      F=K*Q(1)*Q(2)/R^2 "
418  PRINT
419  PRINT "   **********************"
420  PRINT :
     PRINT
425  PRINT "COULOMB FOUND THAT REDUCING EITHER      CHARGE TO HALF ALSO RED
     UCED THE FORCE   TO HALF."
430  PRINT :
     PRINT
440  PRINT "REDUCING EITHER CHARGE TO 1/4 REDUCED   THE FORCE ALSO TO 1/4."
```

```
450  PRINT :
     PRINT
460  PRINT "HOWEVER YOU CAN SEE THAT DOUBLING THE   DISTANCE BETWEEN THE BO
     DIES REDUCED     THE FORCE TO 1/4; TRIPLING THE DISTANCE REDUCED IT TO
      1/9."
465  PRINT :
     PRINT
470  PRINT "PRESS (RETURN) TO CONTINUE":
     GET R$
480  HOME
500  PRINT "PRESS (RETURN) TO BEGIN THE GRAPHING    OF COULOMB'S LAW RELATI
     ONSHIP."
510  GET B$
520  RETURN


   END OF LISTING

   PROGRAM LENGTH: 66 LINES / 1937 BYTES
```

DECWRITER/DRIVER

This program is one that is used when the Apple II+ terminal is connected with a printer that needs a line feed signal (i.e. dec-writer,Anderson-Jacobs, etc.). It commands the machines to advance the paper. Also it changes the character output of the Apple from 40 characters to user defined numbers, up to 132.

```
    1  REM LIST
    2  REM LAST UPDATE:  12/20/80
  100  REM COPYRIGHT 1979 MECC
  110  REM NAME: PRINTER  VERSION 10/18/79
  120  REM AUTHOR: APPLE AND MECC STAFF
  130  REM LANGUAGE: APPLESOFT (FP)
  140  REM ASSOCIATED FILES:NONE
  150  REM
  200  REM INITIALIZATION
  210  TEXT :
       NORMAL :
       HOME :
       SPEED= 255
  230  LET D$ =  CHR$ (4)
  235  PRINT D$"PR#0"
  240  PRINT D$;"NOMON I,C,O"
 1000  REM START OF MAIN PROGRAM
 1001  HOME :
       VTAB 3:
       HTAB 18:
       PRINT "LIST":
       VTAB 10:
       PRINT "THIS PROGRAM WILL PREPARE YOUR HARD COPY ":
       PRINT "PRINTER FOR USE WITH THE APPLE."
 1010  VTAB 16
 1011  PRINT "DO YOU WANT TO USE THE KEYBOARD ON":
       PRINT :
       PRINT "YOUR PRINTER INSTEAD OF THE KEYBOARD":
       PRINT :
       PRINT "ON THE APPLE";:
       INPUT Z$
 1012  IF  LEFT$ (Z$,1) <  > "Y" AND  LEFT$ (Z$,1) <  > "N" THEN
           1000
 1015  LET Z5$ =  LEFT$ (Z$,1)
20200  REM ROUTINE TO POKE PRINTER ROUTINE TO CORE (30 CPS/71 CHAR)
20210  HOME :
       VTAB 5:
       PRINT "TURN YOUR PRINTER ON AT THIS TIME."
20215  VTAB 10
20220  PRINT "WHICH SPEED (10 OR 30 CPS)";
20221  INPUT ZN$:
       IF ZN$ <  > "10" AND ZN$ <  > "30" THEN
           20210
```

```
20230  VTAB 15:
       PRINT "HOW MANY CHARACTERS LONG MAY LINES":
       PRINT :
       PRINT "AT YOUR PRINTER BE";:
       CALL  - 868
20232  INPUT L1$:
       LET L1 =  VAL (L1$):
       IF L1 < 1 OR L1 > 132 THEN
           20230
20233  REM IF YOU WANT THE NEXT QUESTION TO APPEAR THEN TAKE THE REMS OUT OF
       THE NEXT 3 LINES.
20234  REM HOME: VTAB 10: PRINT "DO YOU WANT THE OUTPUT TO APPEAR ON": PRINT
       : PRINT "YOUR SCREEN ALSO";
20238  REM INPUTV$:V$ =  LEFT$ (V$,1): IF V$ <  > "Y" AND V$ <  > "N" THEN 20
       234
20240  LET F1 = 127:
       REM IFV$= "N" THEN F1 = 255
20260  RESTORE
20270  READ Z$:
       IF Z$ <  > "-PRINTER" THEN
           20270
20280  FOR Z = 0 TO 186:
           READ Z1:
           POKE 765 + Z,Z1:
       NEXT
20285  IF ZN$ = "30" THEN
           20288
20286  POKE 802,82:
       POKE 818,82
20288  POKE 823,L1:
       POKE 797,F1
20289  HOME :
       CALL 775
20290  IF Z5$ = "Y" THEN
           PRINT  CHR$ (4) + "IN#2"
20292  POKE 33,33:
       END
30000  REM USER WRITTEN SUBROUTINES
39999  STOP
61000  REM PRINTER ROUTINE
61010  DATA -PRINTER
61050  DATA 76,5,3,2,255,255,255,255,24,176,56,152,72,172,0,3,8,169,5,141,3,3
       ,169,192,24,109,0,3,141,4,3,169,255,153,120,7,169,17,153,248
61060  DATA 7,152,10,10,10,10,168,169,3,153,142,192,169,17,153,142,192,169,15
       5,141,1,3,169,54,133,42,160,0,140,2,3,132,43,40,144,14,173
61070  DATA 231,3,233,110,1 33,42,173,232,3,233,0,133,43,16 9,99,145,42,200,1
       69,3,145,42,104,168,96,72,72,173,2,3,197,00,104,176,3,72,169
61080  DATA 160,44,98,3,240,3,238,2,3,8,32,169,3,40,104,72,144,228,73,13,10,2
       08,13,141,2,3,169,138,32,169,3,169,88,32,168,252,169,0,133
61090  DATA 0,173,2,3,240,9,205,1,3,144,6,176,9,234,234,133,0,104,96,108,3,3,
       169,141,32,169,3,169,0,141,2,3,240,209

       END OF LISTING

       PROGRAM LENGTH: 48 LINES / 2057 BYTES
```

DENSITY

The program density is one where the student is required to input data in two of the variable for the density formula and the third variable will be calculated. It also has an information section about the concept of density. Finally, if the user so desires, the program will compute the specific gravity. Volume data is in cubic centimeters; mass data is in grams. Temperature for the specific gravity calculations in in degrees Celcius.

```
 50  HOME
 60  PRINT "THIS PROGRAM WILL:"
 70  HTAB 1:
     PRINT :
     PRINT "1) GIVE INFORMATION ON DENSITY.
 80  HTAB 1:
     PRINT :
     PRINT "2) COMPUTE DENSITY GIVEN MASS AND VOLUME."
 90  HTAB 1:
     PRINT :
     PRINT "3) COMPUTE MASS GIVEN DENSITY AND VOLUME.
100  HTAB 1:
     PRINT :
     PRINT "4) COMPUTE VOLUME GIVEN DENSITY AND MASS.
110  HTAB 1:
     PRINT :
     PRINT "5) COMPUTE SPECIFIC GRAVITY."
112  HTAB 1:
     PRINT :
     PRINT "6) EXIT PROGRAM."
115  PRINT :
     PRINT :
     PRINT :
     PRINT :
     HTAB 12:
     INPUT "ENTER CHOICE 1-6 ";X
120  GOSUB 3000
130  IF X = 1 THEN
          300
140  IF X = 2 THEN
          500
150  IF X = 3 THEN
          700
160  IF X = 4 THEN
          900
```

```
165  IF X = 5 THEN
         2000
166  IF X = 6 THEN
         3100
170  GOTO 115
300  HOME
302  VTAB 5:
     HTAB 2:
     PRINT "DENSITY IS THE RELATION OF THE MASS"
304  PRINT :
     HTAB 2:
     PRINT "OF AN OBJECT TO ITS VOLUME."
306  PRINT :
     HTAB 2:
     PRINT "IT IS COMPUTED BY DIVIDING THE MASS"
308  PRINT :
     HTAB 2:
     PRINT "BY THE VOLUME.
310  PRINT :
     HTAB 2:
     PRINT "ALL OBJECTS HAVE A DENSITY"
312  PRINT :

     HTAB 2:
     PRINT "RELATIVE TO THAT OF WATER."
320  GOSUB 3000
340  GOTO 50
500  HOME
600  PRINT "WHAT IS THE MASS? (G)"
605  INPUT A
610  PRINT :
     PRINT "WHAT IS THE VOLUME? (CM^3)"
615  INPUT B
620  LET D = A / B
630  PRINT :
     PRINT :
     PRINT "THE DENSITY IS "D" CM^3"
640  GOSUB 3000
650  GOTO 50
700  VTAB 5:
     HTAB 5:
     INPUT "WHAT IS THE DENSITY IN (G/CM^3) ?";D
710  PRINT :
     PRINT :
     HTAB 5:
     INPUT "WHAT IS THE VOLUME IN (CM^3) ?";V
720  LET M = D * V
730  PRINT :
     PRINT :
     PRINT :
     HTAB 5:
     PRINT "THE MASS IS "M" GRAMS"
```

```
 740  GOSUB 3000
 750  GOTO 50
 900  VTAB 5:
      HTAB 3:
      INPUT "WHAT IS THE DENSITY IN (G/CM^3) ? ";D
 910  PRINT :
      PRINT :
      HTAB 3:
      INPUT "WHAT IS THE MASS IN GRAMS ? ";M
 920  LET V = M / D
 930  PRINT :
      PRINT :
      PRINT :
      HTAB 5:
      PRINT "THE VOLUME IS "V" (CM^3)
 940  GOSUB 3000
 950  GOTO 50
1100  PRINT " SORRY! THIS FUNCTION NOT AVAILABLE YET."
2000  VTAB 5:
      HTAB 2:
      INPUT "WHAT IS THE TEMP. (C) ? ";T
2010  LET KM = (999.83952 + 16.945176 * T - 7.9870401 * 10 ^  - 3 * T ^ 2 -
      46.170461 * 10 ^  - 6 * T ^ 3 + 105.56302 * 10 ^  - 9 * T ^ 4 - 280.54
      253 * 10 ^  - 12 * T ^ 5) / (1 + 16.879850 * 10 ^  - 3 * T)
2020  LET RD = KM / 1000
2030  PRINT :
      PRINT :
      PRINT :
      HTAB 3:
      PRINT "THE DENSITY OF WATER AT "T" DEGREES"
2035  LET Z = 10
2040  PRINT :
      HTAB Z:
      PRINT "IS "RD" (G/CM^3)"
2050  PRINT :
      PRINT :
      HTAB 2:
      INPUT "WHAT IS THE DENSITY OF THE UNKNOWN ";D
2060  LET SG = D / RD
2070  PRINT :
      PRINT :
      PRINT :
      HTAB 5:
      PRINT "THE SPECIFIC GRAVITY IS "SG
2080  GOSUB 3000
2100  GOTO 50
3000  VTAB 23:
      HTAB 10:
      PRINT "PRESS ANY KEY TO CONTINUE"
3010  LET Q =  PEEK ( - 16384)
3020  IF Q > 127 THEN
          3040
```

```
3030  GOTO 3010
3040  POKE  - 16368,0
3050  HOME :
      RETURN
3100  HOME :
      PRINT  CHR$ (4);"CATALOG":
      NEW
```

END OF LISTING

PROGRAM LENGTH: 66 LINES / 1763 BYTES

EFFICIENCY

This is a physics program which deals with the efficiency of simple machines. The types of simple machines which it will compute calculations are inclined planes and pulleys. The student is required to input the following data:

a. mass in kg of the weight vector FW

b. the distance or height in meters through which the object of being raised

Then the program will calculate work output. At this point the student will asked for the force exerted on the machine, FA,and the distance, s, in meters through which the machine acts. At this poing the program will compute work input and efficiency.

It should be noted that a B file in machine code is called for in line 20 and is simply some beginning graphics and not necessary for the calculations of the program.

```
10  HOME
20  PRINT  CHR$ (4);"BRUN PRINT"
30  HTAB 5:
    PRINT "^EFFICIENCY OF ^SIMPLE ^MACHINES"
40  PRINT :
    HTAB 19:
    PRINT "BY"
50  PRINT :
    HTAB 13:
    PRINT "^SPENCER ^MORGAN"
60  FOR Q = 1 TO 2500:
    NEXT
70  PRINT :
    PRINT :
    PRINT :
    PRINT :
    HTAB 18:
    PRINT "^FW X H = ^WO"
80  PRINT :
    HTAB 20:
    PRINT "^WO"
90  HTAB 14:
    PRINT "^EFF = -- X 100"
```

```
100  HTAB 20:
     PRINT "^WI"
110  PRINT :
     HTAB 18:
     PRINT "^FA X S = ^WI"
120  GOSUB 3000
130  VTAB 10:
     HTAB 5:
     PRINT "^DO YOU WANT TO:"
140  PRINT :
     HTAB 7:
     PRINT "1) ^CALCULATE ^WO AND ^WI"
150  PRINT :
     HTAB 7:
     PRINT "2) ^CALCULATE ^EFF FROM ^WO & ^WI"
155  PRINT :
     HTAB 7:
     PRINT "3) ^EXIT"
160  PRINT :
     PRINT :
     HTAB 5:
     INPUT "(1/2/3) ? ";B
170  GOSUB 3000
180  IF B = 1 THEN
         200
190  IF B = 2 THEN
         400
192  IF B = 3 THEN
         2000
195  GOTO 130
200  VTAB 5:
     HTAB 5:
     INPUT "^WHAT IS THE MASS IN (^KG) OF ^FW ? ";F1
205  LET FW = F1 * 9.8

210  PRINT :
     HTAB 5:
     INPUT "H EQUALS HOW MANY METERS ? ";H
220  LET WO = FW * H
225  PRINT :
     HTAB 5:
     PRINT "^FW EQUALS "FW" ^NEWTONS"
230  PRINT :
     HTAB 5:
     PRINT "^WO EQUALS "WO
240  PRINT :
     HTAB 5:
     INPUT "^WHAT IS THE MASS IN (^KG) OF ^FA ? ";F2
245  LET FA = F2 * 9.8
250  PRINT :
     HTAB 5:
     INPUT "S EQUALS HOW MANY METERS ? ";S
260  LET WI = FA * S
```

```
265  PRINT :
     HTAB 5:
     PRINT "^FA EQUALS "FA" ^NEWTONS"
270  PRINT :
     HTAB 5:
     PRINT "^WI EQUALS "WI
280  GOSUB 3000
290  GOTO 130
400  VTAB 5:
     HTAB 5:
     INPUT "^DID YOU JUST CALCULATE ^WO & ^WI ? ";A$
405  GOSUB 3000
410  IF A$ = "N" THEN
          420
415  IF A$ = "Y" THEN
          450
417  GOTO 400
420  VTAB 5:
     HTAB 5:
     INPUT "^WHAT DOES ^WO EQUAL ? ";WO
430  PRINT :
     HTAB 5:
     INPUT "^WHAT DOES ^WI EQUAL ? ";WI
450  LET EF = (WO / WI) * 100
455  VTAB 10
460  PRINT :
     PRINT :
     PRINT :
     HTAB 5:
     PRINT "^EFF EQUALS "EF
470  GOSUB 3000
480  GOTO 130
2000 PRINT  CHR$ (4);"CATALOG"
2010 NEW
3000 VTAB 23:
     HTAB 10:
     PRINT "^PRESS ANY KEY TO CONTINUE"
3010 LET Q =  PEEK ( - 16384)
3020 IF Q > 127 THEN
          3040
```

```
3030  GOTO 3010
3040  POKE  - 16368,0
3050  PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT
3060  RETURN
3070  HOME
```

END OF LISTING

PROGRAM LENGTH: 58 LINES / 1320 BYTES

E FIELD

This program will calculate the force on a test charge due to a single point charge, a line of charge, or a sheet of charge. A choice is given as to which problem is to be dome. If the line of charge is chosen, the number of charge along the line must be stated. If the sheet of charge is selected, the number of rows of charge must be stated. Distance to the test charge is also required.

Results obtained: The force contributions are given for each charge along the line and from each row of charge in the sheet along with the resultant force due to the line or sheet of charge.

```
 10  REM  HP/APPLE BAS\LIBRARY
 20  REM
 30  REM        EFIELD
 40  REM
 50  REM  ELEC. FIELD STRENGTH
 60  REM
 70  REM     DOS VER. 3.3
 80  REM
 90  REM    WRITTEN FOR APPLE
100  REM         BY:
110  REM      TROY OWENS
120  REM
130  REM     DATE: 7/27/81
140  REM
150  REM  ********************
160  REM   IMPORTANT VARIBLES
170  REM  'F' TYPE VARIBLES ARE FORCES
180  REM  WE HAVE CHOSEN THE ELECTROSTATIC CONSTANT TO BE ONE & ALL CHARGES
      TO BE ONE SO THAT THE FORCE CALCULATED IS JUST RELATIVE FORCE.
190  REM  IF YOU WOULD LIKE YOU, CAN CHANGE THINGS WHEN YOU RUN IT,TO GET E
     XACT FORCES IN NEWTONS MICROCOULOMBS, OR WHATEVER YOU MAY WISH.
200  HOME
210  PRINT "THIS PROGRAM WILL CALCULATE"
220  PRINT "THE FORCE ON A TEST CHARGE"
230  PRINT "THAT IS PLACED 'Y' DISTANCE"
240  PRINT "AWAY FROM ANOTHER CHARGE;"
250  PRINT "A LINE OF CHARGE; AND"
260  PRINT "A PLANE OF CHARGE.."
270  FOR X = 1 TO 5:
         PRINT :
     NEXT X
```

```
280  PRINT "PRESS A KEY TO CONTINUE."
290  GET A$
300  HOME
310  PRINT "YOU MUST ENTER THE DISTANCE"
320  PRINT "AWAY 'Y'"
330  PRINT "THE SPACING DESIRED BETWEEN"
340  PRINT "CHARGES 'C'"
350  PRINT "AND ALSO BETWEEN LINES OF"
360  PRINT "CHARGE THAT MAKE UP THE "
370  PRINT "PLANE OF CHARGE. "
380  FOR X = 1 TO 4:
         PRINT :
     NEXT X
390  PRINT "PRESS A KEY TO CONTINUE.."
400  GET A$
410  HOME
420  PRINT "YOU MUST ALSO CHOOSE THE "
430  PRINT "NUMBER OF CHARGES IN THE "
440  PRINT "LINE OF CHARGE THAT YOU WOULD"
450  PRINT "LIKE TO USE.."
460  PRINT
470  PRINT "(500 IS A GOOD NUMBER TO USE"
480  PRINT "IF YOU USE A SPACING OF .1"
490  PRINT "FOR 'C')"
500  PRINT
510  PRINT "THIS WILL BE ASKED FOR AS 'N'"
520  FOR X = 1 TO 4:
         PRINT :
     NEXT X
530  PRINT "PRESS A KEY TO CONTINUE..."
540  GET A$
550  HOME
560  PRINT "JUST SO THAT THE CALCULATIONS"
570  PRINT "DON'T GO TOO FAR I'VE INCLUDED"
580  PRINT "A STOP THAT DEPENDS UPON THE "
590  PRINT "ANGLE FROM THE TEST CHARGE TO"
600  PRINT "THE LAST CHARGE TO BE "
610  PRINT "CALCULATED....."
620  PRINT
630  PRINT "IF THE ANGLE IS LESS"
640  REM  Q1 & Q2 ARE THE CHARGES
650  LET Q1 = 1:
     LET Q2 = 1
660  REM  K IS THE ELECTROSTATIC CONSTANT
670  REM  A IS THE CUTOFF ANGLE. THIS MAY BE CHANGED TO YOUR PREFERENCE._
680  LET K = 1:
     LET A = 2
690  PRINT "THAN "A" DEGREES, CALCULATIONS WILL CEASE."
700  FOR X = 1 TO 4:
         PRINT :
     NEXT X
```

```
710  PRINT "TO REPEAT INSTRUCTIONS PRESS 'R' & THEN RETURN."
720  PRINT "PRESS RETURN ONLY TO BEGIN."
730  INPUT B$
740  IF B$ = "R" THEN
         GOTO 200
750  LET S =  SIN (3.14159 * A / 180)
760  HOME
770  PRINT
780  LET F1 = 0
790  PRINT
800  PRINT "WHAT IS THE DISTANCE"
810  PRINT "BETWEEN THE TEST "
820  PRINT "CHARGE & THE "
830  PRINT "EXPERIMENTAL CHARGE?"
840  PRINT "      (  'Y'  )"
850  INPUT Y
860  PRINT
870  PRINT "WHAT IS THE SPACE BETWEEN CHARGES?"
880  PRINT "      (  'C'  )"
890  INPUT C
900  PRINT
910  PRINT "HOW MANY CHARGES ARE THERE IN A"
920  PRINT "LINE OF CHARGE ?  (500) "
930  PRINT "        (  'N'  )"
940  INPUT N
950  IF C <  = 0 THEN
         980
960  IF Y <  = 0 THEN
         980
970  IF N >  = 0 THEN
         1000
980  PRINT "ONE OF YOUR VALUES IS UNREASONABLE.":
     FOR X = 1 TO 500:
     NEXT X
990  GOTO 770
1000 HOME
1010 PRINT :
     PRINT :
     PRINT
1020 PRINT " NO. OF CHGS."
1030 PRINT " ON EACH SIDE "," FORCE "
1040 PRINT "--------------","-------"
1050 FOR I = 0 TO N
1060     LET X = I * C
1070     LET R =  SQR (X * X + Y * Y)
1080     LET F = K * Q1 * Q2 / (R * R)
1090     IF I <  > 0 THEN
             1120
1100     LET F1 = F * Y / R
1110     GOTO 1130
1120     LET F1 = F1 + 2 * F * (Y / R)
1130     IF I <  = 10 THEN
             1200
```

```
1140      IF I = 1000 *  INT (I / 1000) THEN
              1200
1150      IF I > 1000 THEN
              1220
1160      IF I = 100 *  INT (I / 100) THEN
              1200
1170      IF I > 100 THEN
              1220
1180      IF I = 10 *  INT (I / 10) THEN
              1200
1190      GOTO 1220
1200      PRINT I, INT (100 * F1 + .5) / 100
1210      IF N = 0 THEN
              760
1220      IF Y / R < S THEN
              1250
1230  NEXT I
1240  GOTO 1280
1250  HOME :
      PRINT I, INT (100 * F1 + .5) / 100
1260  PRINT "EXCESSIVE COMPUTER TIME WOULD BE REQUIRED TO CALCULATE "
1270  PRINT "THE FORCE FOR ADDITIONAL CHARGES."
1280  PRINT :
      PRINT
1290  PRINT "THE EXACT VALUE FOR AN INFINITELY LONG LINE OF CHARGE IS:";
1294  FOR X = 1 TO 3:
          PRINT :
      NEXT X
1295  PRINT "PRESS A KEY TO CONTINUE":
      GET A$
1300  PRINT 2 * (K * Q1 / C) / Y
1310  PRINT :
      PRINT :
      PRINT
1320  PRINT "NOW ADD ROWS ON EITHER SIDE OF THE LINE OF CHARGE JUST"
1330  PRINT "CALCULATED.  THE SPACING BETWEEN ROWS WILL BE THE SAME AS"
1340  PRINT "THE SPACING BETWEEN THE CHARGES.
1350  PRINT :
      PRINT :
      PRINT "PRESS A KEY TO CONTINUE....":
      GET A$
1360  HOME :
      PRINT "ENTER THE NUMBER OF EQUALLY SPACED ROWS YOU WANT ON EACH SIDE."
1370  INPUT M
1380  IF M >  = 0 THEN
          1410
1390  HOME :
      PRINT "NO NEGITIVE VALUES, PLEASE."
1400  GOTO 1360
1410  HOME :
      PRINT "NO. OF LINES"
1420  PRINT "ON EACH SIDE"," FORCE"
1430  PRINT "------------","------"
```

```
1440  FOR P = 0 TO M
1450      LET Z = P * C
1460      LET R1 =  SQR (Z ^ 2 + Y ^ 2)
1470      IF P <  > 0 THEN
              1500
1480      LET F3 = 2 * (K * Q1 / C) / Y
1490      GOTO 1510
1500      LET F3 = F3 + 2 * F1 * (Y ^ 2) / (R1 ^ 2)
1510      IF P = 1000 *  INT (P / 1000) THEN
              1570
1520      IF P > 1000 THEN
              1580
1530      IF P = 100 *  INT (P / 100) THEN
              1570
1540      IF P > 100 THEN
              1580
1550      IF P = 10 *  INT (P / 10) THEN
              1570
1560      IF P > 10 THEN
              1580
1570      PRINT P, INT (100 * F3 + .5) / 100
1580      IF Y / R1 < S THEN
              1610
1590  NEXT P
1600  GOTO 1630
1610  HOME :
      PRINT "EXCESSIVE COMPUTER TIME WOULD BE REQUIRED TO CALCULATE"
1620  PRINT "THE FORCE FOR ADDITIONAL LINE OF CHARGE."
1630  HOME :
      PRINT :
      PRINT "THE EXACT VALUE FOR AN INFINITE PLANE OF CHARGE IS:";
1635  FOR X = 1 TO 4:
          PRINT :
      NEXT X
1636  PRINT "PRESS A KEY TO CONTINUE":
      GET A$
1640  PRINT 2 * 3.14159 * (K * Q1) / (C ^ 2)
1650  PRINT :
      PRINT
1660  PRINT "DO YOU WANT ANOTHER RUN ? (Y/N)"
1670  GET S$
1680  IF S$ = "Y" THEN
          760
1690  END


      END OF LISTING

      PROGRAM LENGTH: 173 LINES / 4234 BYTES
```

ELECTRICAL EQUIVALENT

In this physics program the student is expected to have completed at least one trial of an experiment called the Electical Equivalent of Heat. The student is given a choice of calculations that can be performed: electric energy and cummulative energy, heat absorbed, electrical equivalent of heat, and efficiency of the system.

Data that the program requires is:

a. time interval used

b. amount of current in amps

c. amount of voltage

d. mass of water

e. change in temperature

```
 10  HOME
 20  FLASH
 30  PRINT "ELECTRICAL EQUIVALENT OF HEAT"
 40  NORMAL
 41  VTAB 8:
     HTAB 16
 42  PRINT " BY   MIKE KRESSER"
 43  PRINT :
     PRINT
 44  HTAB 17
 45  PRINT " AND   C.W ILIFF"
 46  SPEED= 0
 49  PRINT "
 50  GR
 60  COLOR= 15
 65  LET WILL = WILL
 70  VLIN 0,39 AT WILL
 80  LET WILL = WILL + 1
 90  IF WILL < 40 THEN
         GOTO 70
 93  SPEED= 255
 95  COLOR= 0
100  VLIN 39,9 AT 1
110  HLIN 1,5 AT 9
120  HLIN 14,35 AT 9
130  VLIN 39,13 AT 16
140  HLIN 16,23 AT 13
150  VLIN 13,27 AT 23
```

```
160  VLIN 9,27 AT 35
170  PLOT 24,15
180  PLOT 34,15
190  COLOR= 1
200  VLIN 5,14 AT 6
210  VLIN 5,14 AT 13
220  HLIN 6,13 AT 5
230  HLIN 6,13 AT 14
240  VLIN 12,20 AT 25
250  VLIN 12,20 AT 33
260  HLIN 25,33 AT 12
270  HLIN 25,33 AT 20
280  COLOR= 8
290  VLIN 23,32 AT 20
300  VLIN 33,34 AT 21
310  VLIN 35,36 AT 22
320  VLIN 37,38 AT 23
330  HLIN 24,34 AT 39
340  VLIN 38,37 AT 34
350  VLIN 36,35 AT 35
360  VLIN 36,35 AT 35
370  VLIN 34,33 AT 36
380  VLIN 32,23 AT 37
390  COLOR= 4
400  VLIN 24,32 AT 21
410  VLIN 24,34 AT 22
420  VLIN 29,36 AT 23
430  FOR X = 24 TO 33:
         VLIN 24,39 AT X:
     NEXT
440  VLIN 24,36 AT 34
450  VLIN 29,34 AT 35
460  VLIN 24,32 AT 36
470  COLOR= 9
480  PLOT 23,28
490  PLOT 24,29
500  PLOT 25,30
510  PLOT 26,29
520  PLOT 27,28
530  PLOT 28,29
540  PLOT 29,30
550  PLOT 30,29
560  PLOT 31,28
570  PLOT 32,29
580  PLOT 33,30
590  PLOT 34,29
600  PLOT 35,28
610  COLOR= 1
620  VLIN 8,11 AT 8
630  VLIN 8,11 AT 11
640  HLIN 9,10 AT 7
650  HLIN 9,10 AT 9
660  PLOT 27,14
```

```
670  PLOT 31,14
680  PLOT 29,17
690  VLIN 15,16 AT 28
700  VLIN 15,16 AT 30
705  COLOR= 8
710  HLIN 23,33 AT 39
720  PRINT " PRESS ANY KEY TO CONTINUE"
730  GET A$
740  IF A$ = "" THEN
         730
750  TEXT :
     HOME
755  PRINT :
     PRINT
760  HTAB 16
765  INVERSE
770  PRINT "MENU"
775  PRINT :
     PRINT
780  PRINT " PICK THE LETTER OF THE CALC. YOU WANT";
785  PRINT :
     PRINT
790  NORMAL
795  PRINT "A)  ELECTRIC ENERGY & CUMMULATIVE E "
800  PRINT
805  PRINT "B) HEAT ABSORBED"
810  PRINT
815  PRINT "C) ELECTRICAL EQUIVALENT OF HEAT"
816  PRINT :
     PRINT "D) END PROGRAM"
820  PRINT :
     PRINT :
     PRINT
830  PRINT "WHICH CALCULATION DO YOU NEED ";

840  INPUT CA$
850  IF CA$ = "A" THEN
         GOTO 990
860  IF CA$ = "B" THEN
         GOTO 4070
870  IF CA$ = "C" THEN
         GOTO 8000
880  IF CA$ = "D" THEN
         END
990  HOME
1030 PRINT "--WHAT IS THE TIME INTERVAL USED ";
1040 INPUT TI
1050 PRINT
1060 PRINT "--WHAT IS THE AMOUNT OF CURRENT (AMPS)";
1070 INPUT C
1080 PRINT
1090 PRINT "--WHAT IS THE AMOUNT OF VOLTAGE ";
```

```
2000  INPUT V
2010  PRINT
2050  PRINT
2060  HOME
2070  PRINT :
      PRINT
2080  HTAB 16
2090  INVERSE
3000  PRINT "RESULTS"
3010  NORMAL
3012  PRINT :
      PRINT
3015  LET EE = TI * V * C
3020  PRINT "--ELECTRICAL ENERGY (IN JOULES) =";
3030  PRINT EE
3040  PRINT
3050  LET E = 0
3055  PRINT "--CUMULATIVE E =";
3060  FOR Q = 1 TO 16
3070      LET E = E + EE
3090      PRINT E;
4000      PRINT "   ,   ";
4010  NEXT Q
4012  PRINT :
      PRINT :
      PRINT :
      PRINT
4015  PRINT "PRESS ANY KEY TO CONTINUE"
4017  GET A$
4018  IF A$ <  > "" THEN
          GOTO 750
4020  HOME
4030  PRINT
4040  HTAB 16
4050  INVERSE :
      PRINT "RESULTS"
4060  PRINT :
      PRINT
4063  INVERSE
4065  PRINT "              FOR HEAT ABSORBED"
4067  NORMAL

4070  HOME :
      PRINT
4073  INVERSE
4075  PRINT "        HEAT ABSORBED (CAL)"
4077  NORMAL :
      PRINT :
      PRINT
4080  PRINT "--YOU MUST INPUT 16 SEPARATE VALUES "
4090  PRINT "  FOR DT.  THERE WILL BE SEPARATE "
5000  PRINT "  CALCULATIONS FOR EACH VALUE. "
5010  PRINT
```

```
5012  PRINT "WHAT IS THE MASS OF THE WATER ";
5013  INPUT MW
5015  FOR W = 1 TO 15
5020      PRINT "--WHAT DOES DELTA T = ";
5030      INPUT CT
5035      LET HA = CT * MW
5037      LET Z = Z + HA
5040      PRINT " HEAT ABSORBED =";:
          PRINT HA
5050      PRINT
5060  NEXT W
5070  PRINT :
      PRINT :
      PRINT :
      PRINT
5077  PRINT
5080  PRINT "PRESS ANY KEY TO CONTINUE"
5090  GET A$
6000  IF A$ <  > "" THEN
          GOTO 750
6010  NORMAL
8000  HOME
8010  INVERSE
8015  PRINT
8020  PRINT " ELECTRICAL EQUIVALENT OF HEAT "
8025  NORMAL
8030  PRINT :
      PRINT :
      PRINT
8035  PRINT "FOR LAST CALC. CUMULATIVE E WAS ";E
8036  PRINT
8040  PRINT "--WHAT IS THE FINAL CUMULATIVE E ";
8050  INPUT CE
8055  IF CE = 0 THEN
          PRINT :
          PRINT "CUMULATIVE ENERGY CANNOT BE 0":
          GOTO 8050
8060  PRINT
8065  PRINT "FOR LAST CALC. FINAL CUM. Q WAS ";Z
8066  PRINT
8070  PRINT "--WHAT IS THE FINAL CUMULATIVE Q ";
8080  INPUT CQ
8085  IF CQ = 0 THEN
          PRINT :
          PRINT "CUMULATIVE Q CANNOT BE 0":
          GOTO 8080
8090  LET R = CE / CQ
```

```
9000  PRINT :
      PRINT :
      PRINT
9010  PRINT "THE ELECTRICAL EQUIVALENT OF HEAT = ";
9020  PRINT R
9030  LET EF = CQ / CE * 100
9040  PRINT :
      PRINT
9050  LET EF = EF * 1000:
      LET EF =  INT (EF):
      LET EF = EF / 1000
9060  PRINT "EFFICIENCY OF THE SYSTEM = ";
9070  PRINT EF
9080  PRINT :
      PRINT
```

END OF LISTING

PROGRAM LENGTH: 199 LINES / 3049 BYTES

EMISSION SPECTRUM

This program deals with the section of the electromagnetic spectrum known as the optical spectrum which includes those radiations commonly called light that can be detected visually. They range from approximately 7600°A to 4000°A. The optical spectrum extends into the near infrared and into the near ultraviolet but cannot be detected with our eyes and therefore do not appear on this program.

Data Input

(a) request for information

(b) request to view the continuous spectrum

(c) viewing of the sodium spectrum

(d) viewing of the lithium spectrum

(e) viewing of the hydrogen spectrum

(f) viewing of the helium spectrum

Results Received

A graphics display of the various spectra requested placed under the display of the continuous spectrum for comparison. Corresponding °A units are indicated.

Limitations

Since color graphics programs, even those done in high resolution graphics, are based on squares of color, it is impossible to create a continuous spectrum where one color blends into the next. Therefore, the color bands will have distcrete boundaries. The other spectra are discrete lines anyways, so no problems occur there. There does exist a word of advice to those who might be using a large color TV for a monitor with this program: be sure to adjust the color on the TV early in the program to match a printed spectrum in a physics or chemistry text.

```
 10  GOTO 630
 20  HOME
 30  VTAB 5
 40  HTAB 4
 50  PRINT "THE FOLLOWING IS AN EXPLANATION OF"
 60  HTAB 10
 70  VTAB 9
 80  INVERSE
 90  PRINT "THE EMISSION SPECTRUM"
100  NORMAL
110  VTAB 22
120  INPUT "PRESS RETURN TO CONTINUE...";T$
130  IF T$ = " " THEN
         140
140  HOME
150  PRINT "THE ELECTROMAGNETIC SPECTRUM MAY"
160  PRINT
170  PRINT "BE DIVIDED INTO EIGHT MAJOR REGIONS"
180  PRINT
190  PRINT "THEY ARE :"
200  PRINT
210  PRINT "1)ELECTRIC WAVES"
220  PRINT
230  PRINT "2)RADIO WAVES"
240  PRINT
250  PRINT "3)INFRARED"
260  PRINT
270  PRINT "4)OPTICAL"
280  PRINT
290  PRINT "5)ULTRAVIOLET"
300  PRINT
310  PRINT "6)X-RAYS"
320  PRINT
330  PRINT "7)GAMMA RAYS"
340  PRINT
350  PRINT "8)HARD GAMMA RAYS"
360  PRINT
370  PRINT
380  INPUT "PRESS RETURN TO CONTINUE...";E$
390  IF E$ = " " THEN
         400
400  HOME
410  HTAB 4
420  PRINT "THE OPTICAL SPECTRUM INCLUDES THOSE"
430  PRINT
440  PRINT "RADIATIONS, COMMONLY CALLED LIGHT, THAT"
450  PRINT
460  PRINT "CAN BE DETECTED VISUALLY."
470  PRINT :
     PRINT
480  HTAB 4
490  PRINT "THEY RANGE FROM APPROXIMATELY 7600"
500  PRINT
510  PRINT "TO 4000 ANGSTROMS."
520  PRINT :
     PRINT
530  VTAB 14
```

```
540  HTAB 4
550  INVERSE :
     PRINT "LIGHT";:
     NORMAL
560  HTAB 10
570  PRINT "MAY BE DEFINED AS RADIANT"
580  PRINT
590  PRINT "ENERGY WHICH THE HUMAN OBSERVER CAN SEE."
600  VTAB 22
610  INPUT "PRESS RETURN TO CONTINUE...";Y$
620  GOTO 870
630  CALL  - 936
640  VTAB 5
650  HTAB 11
660  PRINT "PROGRAM WRITTEN BY"
670  PRINT
680  PRINT
690  HTAB 13
700  PRINT "SCOTT SCHAFER"
710  PRINT
720  HTAB 19:
     PRINT "&"
730  PRINT
740  HTAB 13
750  PRINT "JONATHAN BELL"
760  PRINT
770  HTAB 19:
     PRINT "&"
780  PRINT
790  HTAB 6
800  PRINT "DR. MARCELLINE A. BARRON"
810  PRINT
820  HTAB 13
830  PRINT "(C-MAR.-1982)"
840  VTAB 22
850  INPUT "PRESS ANY KEY TO CONTINUE.....";T$
860  IF T$ = " " THEN
         870
870  HOME
880  INVERSE
890  VTAB 2
900  HTAB 14
910  PRINT "SPECTRUM MENU"
920  PRINT :
     PRINT :
     PRINT
930  NORMAL
940  PRINT "1) SODIUM (NA)"
950  PRINT
960  PRINT "2) LITHIUM (LI)"
970  PRINT
980  PRINT "3) HYDROGEN (H)"
990  PRINT
1000 PRINT "4) HELIUM (HE)"
1010 PRINT
```

```
1020  PRINT "5) CONTINUOUS SPECTRUM"
1030  PRINT
1040  PRINT "6) EXIT PROGRAM"
1050  PRINT
1060  PRINT "7) INFORMATION"
1070  VTAB 22
1080  INPUT "ENTER YOUR CHOICE ?";A
1090  IF A = 1 THEN
          1540
1100  IF A = 2 THEN
          1670
1110  IF A = 3 THEN
          1840
1120  IF A = 4 THEN
          2020
1130  IF A = 5 THEN
          2230
1140  IF A = 6 THEN
          2300
1150  IF A = 7 THEN
          20
1160  GR
1170  LET A = 5
1180  HOME
1190  COLOR= 13
1200  VLIN A,A + 8 AT 19
1210  VLIN A,A + 8 AT 20
1220  VLIN A,A + 8 AT 21
1230  VLIN A,A + 8 AT 22
1240  COLOR= 9
1250  VLIN A,A + 8 AT 18
1260  VLIN A,A + 8 AT 17
1270  VLIN A,A + 8 AT 16
1280  VLIN A,A + 8 AT 15
1290  VLIN A,A + 8 AT 14
1300  VLIN A,A + 8 AT 13
1310  VLIN A,A + 8 AT 12
1320  COLOR= 1
1330  FOR X = 11 TO 0 STEP  - 1
1340      VLIN A,A + 8 AT X:
      NEXT
1350  COLOR= 12
1360  FOR X = 23 TO 35
1370      VLIN A,A + 8 AT X:
      NEXT
1380  COLOR= 6
1390  FOR X = 30 TO 33
1400      VLIN A,A + 8 AT X:
      NEXT
1410  COLOR= 2
1420  FOR X = 34 TO 39
1430      VLIN A,A + 8 AT X:
      NEXT
```

```
1440  VTAB 22
1450  PRINT "7400 (ANG)";:
      HTAB 14:
      PRINT "6200";
1460  HTAB 20
1470  PRINT "5959";:
      HTAB 26:
      PRINT "5400";:

      HTAB 37:
      PRINT "4000"
1480  HTAB 8:
      INVERSE
1490  RETURN
1500  PRINT "CONTINUOUS SPECTRUM"
1510  END
1520  FOR X = 1 TO 4000:
      NEXT
1530  RETURN
1540  HOME
1550  REM  SODIUM SPECTRUM
1560  GOSUB 1160
1570  COLOR= 13
1580  LET A = 20
1590  VLIN A,A + 4 AT 19
1600  VLIN A,A + 4 AT 22
1610  HTAB 8
1620  PRINT "SODIUM (NA) SPECTRA"
1630  FOR X = 1 TO 20000:
      NEXT
1640  TEXT
1650  HOME
1660  GOTO 870
1670  HOME
1680  REM  LITHIUM SPECTRUM
1690  GOSUB 1160
1700  LET A = 20
1710  COLOR= 1
1720  VLIN A,A + 4 AT 9
1730  COLOR= 9
1740  VLIN A,A + 4 AT 14
1750  COLOR= 6
1760  VLIN A,A + 4 AT 30
1770  COLOR= 2
1780  VLIN A,A + 4 AT 35
1790  PRINT " LITHIUM (LI) SPECTRA"
1800  FOR X = 1 TO 20000:
      NEXT
1810  HOME
1820  TEXT
1830  GOTO 870
1840  HOME
```

```
1850  REM  HYDROGEN SPECTRUM
1860  GOSUB 1160
1870  COLOR= 9
1880  LET A = 20
1890  VLIN A,A + 4 AT 13
1900  COLOR= 6
1910  VLIN A,A + 4 AT 30
1920  COLOR= 2
1930  VLIN A,A + 4 AT 34
1940  VLIN A,A + 4 AT 38
1950  COLOR= 1
1960  VLIN A,A + 4 AT 7
1970  PRINT "HYDROGEN (H) SPECTRA"
1980  FOR X = 1 TO 20000:
      NEXT
1990  HOME
2000  TEXT
2010  GOTO 870
2020  HOME
2030  REM  HELUIM SPECTRUM
2040  GOSUB 1160
2050  COLOR= 1
2060  LET A = 20
2070  VLIN A,A + 4 AT 5
2080  COLOR= 1
2090  VLIN A,A + 4 AT 9
2100  COLOR= 13
2110  VLIN A,A + 4 AT 21
2120  COLOR= 6
2130  VLIN A,A + 4 AT 30
2140  COLOR= 2
2150  VLIN A,A + 4 AT 35
2160  VLIN A,A + 4 AT 39
2170  VLIN A,A + 4 AT 37
2180  PRINT " HELIUM (HE) SPECTRA"
2190  FOR X = 1 TO 20000:
      NEXT
2200  HOME
2210  TEXT
2220  GOTO 870
2230  HOME
2240  GOSUB 1160
2250  PRINT "CONTINUOUS SPECTRUM"
2260  FOR X = 1 TO 40000:
      NEXT
2270  HOME
2280  TEXT
2290  GOTO 870
2300  HOME
2310  PRINT "THANK YOU FOR YOUR TIME"
2320  END

PROGRAM LENGTH: 232 LINES / 3143 BYTES
```

ENTHALPY

Enthalpy is a program which applies high resolution graphics to illustrate for the chemistry student the various curves possible when studying heat content of various types of reactions. The reactions illustrated are exothermic, endothermic, spontaneous, and reactions with catalysts. Information about the concept of enthalphy is also available. It should be noted that the program calls up various B files in machine code which are not available here.

```
 10  CALL  - 936
 20  VTAB 10
 30  HTAB 16
 40  PRINT "ENTHALPY"
 45  VTAB 12:
     HTAB 19:
     PRINT "BY"
 50  VTAB 14:
     HTAB 11:
     PRINT "JONATHAN BELL &"
 60  VTAB 16:
     HTAB 8
 70  PRINT "DR. MARCELLINE BARRON"
 80  VTAB 18:
     HTAB 14
 90  PRINT "C-MAR-1982"
 95  FOR X = 1 TO 5000:
     NEXT
100  TEXT :
     HOME
200  VTAB 4
300  HTAB 8
350  INVERSE
400  PRINT "ENTHALPY (HEAT CONTENT)"
450  NORMAL
500  VTAB 9
600  PRINT "1) EXOTHERMIC"
700  PRINT
800  PRINT "2) ENDOTHERMIC"
850  PRINT
900  PRINT "3) WITH CATALYST"
950  PRINT
1000 PRINT "4) SPONTANEOUS"
1050 PRINT
1100 PRINT "5) INFORMATION"
1150 PRINT
```

```
1200  PRINT "6) EXIT  "
1250  PRINT :
      PRINT
1300  PRINT "WHICH OF THESE WOULD YOU PREFER?";
1350  GET A
1700  IF A = 1 GOTO 2500
1750  IF A = 2 GOTO 4600
1775  IF A = 3 GOTO 7825
1800  IF A = 4 GOTO 6400
1850  IF A = 5 GOTO 10200
1900  IF A = 6 GOTO 2000
2000  HOME
2010  VTAB 10:
      HTAB 8:
      PRINT "THANK YOU FOR YOUR TIME"
2020  END
2500  HOME
2600  HGR
2605  POKE  - 16303,0
2607  HTAB 10:
      VTAB 10:
      PRINT "ONE MOMENT PLEASE...."
2610  LET D$ =  CHR$ (4)
2620  PRINT D$;"BLOAD EXO"
2630  POKE  - 16304,0
2650  HCOLOR= 3
2820  LET LAMB = 37.6
2840  LET WAVE = 26.857
2900  FOR N = 21 TO 87
3000      LET PI = 3.14159
3100      LET ALPH = N * 2 * PI / 1000
3200      LET BETA = N * 2 * PI / 85
3300      LET BOT = 20 *  COS (ALPH)
3400      LET POT = 50 *  COS (BETA)
3500      LET SUM = POT + BOT
3550      HPLOT N,72 + POT
3575      HPLOT 20,72 TO N,72
3900  NEXT N
4000  HPLOT 85,121 TO 250,121
4100  HPLOT 47,72 TO 47,22
4200  HPLOT 87,121 TO 87,72
4300  HPLOT 46,22
4400  FOR X = 1 TO 20000:
      NEXT
4500  GOTO 100
4600  HOME :
      HTAB 10:
      PRINT "ONE MOMENT PLEASE"
4650  HGR
4700  PRINT  CHR$ (4);"BLOAD ENDO"
4750  HCOLOR= 3
4800  FOR X = 1 TO 7000:
      NEXT
```

```
4900  LET LAMB = 37.6:
      LET WAVE = 26.857
5000  FOR N = 20 TO 57
5100      LET PI = 3.14159
5200      LET ALPH = N * 2 * PI / 1000
5300      LET BETA = N * 2 * PI / 85
5400      LET BOT = 20 *  COS (ALPH)
5500      LET POT = 50 *  COS (BETA)
5600      LET SUM = POT + BOT
5700      HPLOT N,78 + POT
5900  NEXT N
6000  HPLOT 57,55 TO 250,55
6100  HPLOT 43,78 TO 43,28
6200  HPLOT 250,55 TO 250,78
6300  FOR X = 1 TO 20000:
      NEXT :
      GOTO 100
6400  HGR :
      PRINT  CHR$ (4);"BLOAD SPON"
6425  HOME
6450  PRINT  CHR$ (4);"BLOAD SPON"
6500  LET LAMB = 37.6:
      LET WAVE = 26.857
6600  FOR N = 20 TO 87
6700      LET PI = 3.14159
6800      LET ALPH = N * 2 * PI / 1000
6900      LET BETA = N * 2 * PI / 85
7000      LET BOT = 20 *  COS (ALPH)
7100      LET POT = 20 *  COS (BETA)
7200      LET SUM = POT + BOT
7300      HPLOT N,78 + POT
7400  NEXT N
7500  HPLOT 88,97 TO 255,97
7600  HPLOT 44,79 TO 44,59
7700  HPLOT 255,97 TO 255,79
7800  FOR X = 1 TO 20000:
      NEXT :
      GOTO 100
7825  HOME
7850  HGR
7855  LET D$ =  CHR$ (4)
7879  PRINT D$;"BLOAD CAT"
7880  PRINT D$;"BLOAD CAT"
7900  FOR N = 20 TO 55
8000      LET PI = 3.14159
8200      LET BETA = N * 2 * PI / 85
8300      LET BOT = 20 *  COS (ALPH)
8400      LET POT = 20 *  COS (BETA)
8500      HPLOT N,78 + POT
8600  NEXT N
8700  FOR Z = 55 TO 66
8750      LET PI = 3.14159
8800      LET BETA = Z * 2 * PI / 85
8900      LET POT = 20 *  COS (BETA) / 2
```

```
 9000      HPLOT Z,71 + POT
 9100  NEXT Z
 9200  FOR R = 67 TO 130
 9300      LET PI = 3.14159
 9400      LET BETA = R * 2 * PI / 85
 9500      LET POT = 35 *  -  COS (BETA)
 9600      HPLOT R,78 + POT
 9700  NEXT R
 9800  HPLOT 130,112 TO 255,112
 9900  HPLOT 255,112 TO 255,78
10000  HPLOT 110,78 TO 110,44
10050  HPLOT 130,44 TO 90,44
10100  FOR X = 1 TO 20000:
       NEXT :
       GOTO 100
10200  HOME
10300  PRINT "      INFORMATION ABOUT ENTHALPY"
10400  PRINT :
       PRINT
10500  PRINT "AS MOLECULES COLLIDE AND REACTIONS TAKE
                    PLACE, THE ATOMS MUST TAKE UP FOR A
                              MOMENT BONDING ARRANGEMENTS THAT ARE "
10600  PRINT
10700  PRINT "LESS STABLE THAN EITHER REACTANTS OR
                    PRODUCTS."
10800  PRINT :
       PRINT :
       PRINT
10900  PRINT "THESE HIGH ENERGY MOLECULAR ARRANGEMENTS
                    PLACE AN ENERGY BARRIER BETWEEN

                              REACTANTS AND PRODUCTS."
10950  PRINT :
       PRINT
11000  PRINT "PRESS ANY KEY TO CONTINUE":
       GET A$
11100  HOME
11200  PRINT "ONLY IF THE COLLIDING MOLECULES HAVE
                    ENOUGH ENERGY TO SURMOUNT THE BARRIER
                              IMPOSED BY THE UNSTABLE ARRANGEMENTS"
11300  PRINT "                                        CAN REACTION TAKE PLACE
       ."
11400  PRINT :
       PRINT :
       PRINT
11500  PRINT "THIS BARRIER DETERMINES THE THRESHOLD
                    ENERGY OR MINIUMUM ENERGY NECESSARY TO
                              PERMIT A REACTION TO OCCUR."
11600  PRINT :
       PRINT :
       PRINT
11700  PRINT "THIS ENERGY IS CALLED THE"
11740  PRINT
```

```
11750  INVERSE
11760  HTAB 18:
       PRINT "ACTIVATION ENERGY!!!"
11770  NORMAL
11800  PRINT
11900  PRINT "PRESS ANY KEY TO CONTINUE":
       GET B$
12000  HOME


  END OF LISTING

  PROGRAM LENGTH: 156 LINES / 3307 BYTES
```

GAS

This program calculates gas mileage and checks engine performance.

Data Input

(a) E.P.A. mileage value

(b) Mileage before filling tank

(c) Mileage after next fill up

(d) No. of gallons of gas required to fill up

Results Returned

Calculated comparison between cars EPA mileage value and actual performance.

```
 10  HOME
100  PRINT  TAB( 9)"GAS MILEAGE CALCULATOR"
110  PRINT
120  PRINT
130  PRINT "THIS PROGRAM CALCULATES GAS MILEAGE"
140  PRINT "AND CHECKS ENGINE PERFORMANCE"
150  PRINT
160  PRINT "ENTER E.P.A. MILEAGE VALUE"
170  INPUT E
180  PRINT
190  PRINT "ENTER MILEAGE BEFORE FILLING TANK"
200  INPUT M
210  PRINT
220  PRINT "ENTER MILEAGE AFTER NEXT FILL UP"
230  INPUT M1
240  PRINT
250  PRINT "ENTER NO. OF GALLONS OF GAS REQUIRED FOR FILL UP"
260  INPUT G
280  LET S = (M1 - M) / G
290  LET T = .90 * E
295  HOME
300  PRINT
310  INVERSE :
     PRINT "MILEAGE=";S;" MILES PER GALLON":
     NORMAL
315  PRINT :
     PRINT :
     PRINT :
     PRINT
320  PRINT "THE E.P.A. MILAGE VALUE ";E
330  PRINT
```

```
340  IF S < T THEN
         390
350  PRINT "YOUR MILEAGE IS CONSISTENT WITH  THE"
360  PRINT "E.P.A. VALUE (WITHIN 10%). YOUR CARS"
370  PRINT "ENGINE SHOULD BE PERFORMING WELL."
380  END
390  HOME
395  PRINT
400  PRINT "YOUR CARS ENGINE IS PERFORMING BELOW THE"
410  PRINT "E.P.A. VALUE BY "E - S;" MILES PER GALLON."
420  INVERSE :
     PRINT  TAB( 8)"HAVE YOUR ENGINE CHECKED."
430  NORMAL :
     PRINT "IT MAY BE IN NEED OF A TUNE-UP."
440  PRINT :
     PRINT :
     PRINT :
     PRINT "AGAIN  (Y/N)?":
     GET Y$
450  IF Y$ = "N" THEN
         END
460  GOTO 10


END OF LISTING

PROGRAM LENGTH: 40 LINES / 877 BYTES
```

GAS/GRAF

This program generates a graph which illustrates Boyle's Law. It is called up in the program IDEAL GAS LAW which can be found elsewhere in this document.

```
 4  TEXT
 9  HOME
10  VTAB 2:
    HTAB 11:
    INVERSE :
    PRINT "BOYLE'S LAW GRAPH":
    NORMAL
15  VTAB 4:
    HTAB 18:
    PRINT "BY"
16  VTAB 6:
    HTAB 17:
    PRINT "BFC1"
20  FOR T = 1 TO 3000:
    NEXT T
30  HGR
40  HCOLOR= 1
41  HPLOT 1,1 TO 1,159
42  HPLOT 0,159 TO 279,159
45  HCOLOR= 5
50  FOR X = 1 TO 279
60      LET Y = 159 - (280 * 8 / X)
70      IF Y < 0 THEN
            100
80      HPLOT X,Y
100 NEXT X
110 VTAB 21
120 PRINT "ABSCISSA=PRESSURE"
130 PRINT "ORDINATE=VOLUME"
135 PRINT
140 HTAB 14:
    PRINT "PRESS SPACEBAR";
150 GET A$:
    IF A$ <  >  CHR$ (32) THEN
        150
160 PRINT  CHR$ (13) +  CHR$ (4)"RUN GAS/GRAF2"
165 HOME
```

END OF LISTING

PROGRAM LENGTH: 24 LINES / 367 BYTES

GAS/GRAF2

This program generates a high resolution graph which illustrates Charles' Law. It is called up in the program IDEAL GAS LAW which can be found elsewhere in this document.

```
 10  HOME
 11  TEXT
 20  VTAB 2:
     HTAB 11:
     INVERSE :
     PRINT "CHARLE'S LAW GRAPH":
     NORMAL
 30  VTAB 4:
     HTAB 19:
     PRINT "BY"
 40  VTAB 6:
     HTAB 18:
     PRINT "BFC1"
 50  REM  BY J. KRUSLING
 60  FOR T = 1 TO 3000:
     NEXT
 70  HGR
 80  HCOLOR= 1
 90  HPLOT 0,159 TO 269,159
100  HPLOT 1,0 TO 1,159
105  HCOLOR= 6
110  HPLOT 1,159 TO 159,0
120  VTAB 21
130  PRINT "ABSCISSA=VOLUME"
140  PRINT "ORDINATE=TEMPERATURE"
150  PRINT :
     HTAB 13:
     PRINT "PRESS SPACEBAR";
160  GET A$:
     IF A$ <  >  CHR$ (32) THEN
         160
170  TEXT :
     HOME
180  PRINT  CHR$ (13) +  CHR$ (4)"RUN IDEAL GAS LAW"
```

END OF LISTING

PROGRAM LENGTH: 20 LINES / 348 BYTES

GRAMS/MOLES

In the program GRAMS/MOLES a simple set of conversions for the chemistry student are made. The student is expected to input data either in grams or in moles and the program will make the appropriate conversion provided the user has given the program the number of grams per one mole for the substance under examination.

```
 1  HOME
 2  PRINT :
    PRINT :
    PRINT :
    PRINT
 3  HTAB 15:
    INVERSE :
    PRINT "GRAMS/MOLES"
 4  PRINT :
    PRINT :
    PRINT :
    PRINT
 5  HTAB 20:
    NORMAL :
    PRINT "BY"
 6  PRINT :
    PRINT :
    PRINT
 7  HTAB 14:
    PRINT "SPENCER MORGAN"
 8  PRINT :
    PRINT :
    PRINT
 9  HTAB 19:
    PRINT "AND"
10  PRINT :
    PRINT :
    PRINT
11  HTAB 9:
    PRINT "DR. MARCELLINE A. BARRON"
12  PRINT :
    PRINT
13  HTAB 18:
    PRINT "C-1982"
14  FOR Y = 1 TO 5000:
    NEXT
15  HOME
```

```
 20  HTAB 14:
     INVERSE :
     PRINT "MENU"
 30  NORMAL :
     PRINT :
     PRINT :
     PRINT
 40  PRINT "1)GRAMS TO MOLES"
 45  PRINT :
     PRINT
 50  PRINT "2)MOLES TO GRAMS"
 60  PRINT :
     PRINT
 62  PRINT "3)EXIT "
 65  VTAB 22
 70  INPUT "WHICH ONE ? (1/2/3)";A
 75  HOME
 80  ON A GOTO 90,145,1000
 90  INPUT "HOW MANY GRAMS ?";B
 95  PRINT :
     PRINT
100  INPUT "HOW MANY GRAMS PER MOLE? ";C
110  LET M = B / C
115  PRINT :
     PRINT :
     PRINT :
     PRINT
120  PRINT "THERE ARE ";M;" MOLES IN ";B;" GRAMS"
130  GOTO 190
145  HOME
150  INPUT "HOW MANY MOLES? ";D
155  PRINT :
     PRINT
160  INPUT "HOW MANY GRAMS PER MOLE? ";E
170  LET G = D * E
175  PRINT :
     PRINT :
     PRINT :
     PRINT
180  PRINT "THERE ARE ";G;" GRAMS IN ";D;" MOLES"
190  FOR X = 1 TO 5000:
     NEXT
200  GOTO 15
1000 HOME :
     END
```

END OF LISTING

PROGRAM LENGTH: 43 LINES / 714 BYTES

HALF LIFE

The program is designed to acquaint the student with the concept of nuclear disintegration and half-life. Some drill and practice plus graphing is included. The student will have to predict from the graph.

Data Input

(a) number of nuclei (N) after two half lifes (T) of decay

(b) number of nuclei (N) after three half lifes (T) of decay

Results Returned

(a) drill and practice on half life values

(b) general decay curve

(c) predicting (N) values and having them evaluated

Limitations

There is quite a bit of descriptive material at the beginning to familiarize the student with the various terms and topics.

```
 90  TEXT :
     HOME
100  REM  A HALF LIFE MODEL OF NUCLEAR DISINTEGRATION
109  INVERSE
110  PRINT "A HALF LIFE MODEL OF NUCLEAR DECAY"
111  NORMAL
115  PRINT :
     PRINT :
     PRINT
116  PRINT "      WRITTEN BY DR. MARCELLINE A. BARR
     ON                    WESTERN HILLS H.S.
120  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
```

```
130  PRINT "PRESS ANY KEY WHEN YOU ARE READY ":
     GET R$
140  HOME
150  PRINT "PHYSICISTS HAVE DEVELOPED A MODEL OF    THE NUCLEUS OF AN ATOM
     THAT PORTRAYS A  NUCLEUS AS A DYNAMIC BUNDLE OF SHIFTING ENERGY PATTER
     NS."
160  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
170  PRINT "PRESS ANY KEY WHEN YOU ARE READY        TO CONTINUE":
     GET W$
180  HOME
190  PRINT "THE POSITIVELY CHARGED PROTONS OF THE   NUCLEUS REPEL EACH OTHE
     R, AND THE       NEUTRONS, WHICH ARE CHARGELESS, ADD     MASS TO THE N
     UCLEUS."
200  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
210  PRINT "PRESS ANY KEY WHEN YOU ARE READY        TO CONTINUE":
     GET X$
220  HOME
230  PRINT "THE FORCES THAT BIND THE NUCLEUS        TOGETHER ARE NOT CLEARL
     Y UNDERSTOOD."
240  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
250  PRINT "PRESS ANY KEY WHEN YOU ARE READY        TO CONTINUE":
     GET Z$
255  HOME
260  PRINT "THE BALANCE BETWEEN THE REPULSION OF    THE PROTONS AND THE BIN
     DING FORCES IN   THE NUCLEUS IS OFTEN DISTURBED, RESULT- ING IN THE EM
     ISSION OF A PARTICLE."
270  PRINT :
     PRINT :
     PRINT :
     PRINT
280  FLASH
```

```
290  PRINT "THIS PROCESS IS CALLED RADIOACTIVE DECAY"
300  NORMAL
305  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
310  PRINT "PRESS ANY KEY TO CONTINUE":
     GET T$
320  HOME
330  PRINT "THE HALF LIFE OF A RADIOACTIVE SAMPLE   IS DEFINED AS THE TIME
     DURING WHICH, ON THE AVERAGE, ONE HALF OF THE RADIOACTIVE NUCLEI WILL
     HAVE DECAYED."
340  PRINT :
     PRINT :
     PRINT :
     PRINT
349  PRINT :
     PRINT :
     PRINT :
     PRINT
350  PRINT "THE HALF LIFE OF RADIUM WITH A NUCLEAR  MASS OF 226 (RADIUM-226
     ) IS 1620 YEARS."
360  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
365  PRINT "PRESS ANY KEY TO CONTINUE":
     GET S$
367  HOME
370  PRINT "HOW LONG WILL IT TAKE FOR HALF OF A     GIVEN SAMPLE OF RADIUM-
     226 TO DECAY?"
380  INPUT "TIME (YEARS)=";T(X)
382  PRINT :
     PRINT :
     PRINT
385  IF T(X) <  > 1620 THEN
         GOTO 390
386  GOTO 400
390  PRINT "NOT QUITE!  TRY AGAIN!":
     GOTO 349
```

```
400  PRINT "VERY GOOD!!"
405  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
406  PRINT "PRESS ANY KEY TO CONTINUE":
     GET P$
410  HOME
420  PRINT "THE HALF LIFE OF POLONIUM-210 IS 140    DAYS.  TIME(T) WILL BE
     IN INCREMENTS    OF 140. THE NUMBER OF NUCLEI (N) WILL EQUAL THE NUMBE
     R OF POLONIUM NUCLEI AT THE BEGINNING OF THE COUNTING."
425  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
430  PRINT "PRESS ANY KEY TO BEGIN THE GRAPHING":
     GET Q$
440  HOME
450  GR
460  COLOR= 4
470  VLIN 0,39 AT 0
480  HLIN 0,39 AT 39
490  COLOR= 15
491  PLOT 0,0
492  PLOT 7,20
493  PLOT 14,30
494  PLOT 21,35
495  PLOT 28,37
496  PLOT 35,37
497  COLOR= 9
498  PLOT 1,1
499  PLOT 2,5
500  PLOT 3,8
501  PLOT 4,12
502  PLOT 5,15
503  PLOT 6,17
504  PLOT 8,22
505  PLOT 9,24
```

```
506  PLOT 10,26
507  PLOT 11,27
508  PLOT 12,28
509  PLOT 13,29
510  PLOT 15,31
511  PLOT 17,33
512  PLOT 19,34
513  PLOT 23,36
514  PLOT 25,37
515  PLOT 27,37
516  PLOT 29,37
517  PLOT 31,37
518  PLOT 33,37
520  PRINT "DECAY CURVE OF NUMBER OF NUCLEI (N)          VERSUS TIME(T)"
525  FOR X = 1 TO 7500:
     NEXT
526  PRINT
530  PRINT "AFTER 140 DAYS OF TIME HAVE GONE BY,   N/2 NUCLEI OF POLONIUM R
     EMAIN."
536  PRINT
540  PRINT "AFTER 2T DAYS OF TIME HAVE PASSED, HOW  MANY NUCLEI OF POLONIUM
      REMAIN?"
545  FOR X = 1 TO 7500:
     NEXT
550  INPUT "NUMBER=";N$
560  IF N$ = "N/4" THEN
         GOTO 600
570  PRINT "TRY AGAIN. BETTER LUCK THIS TIME!"
575  PRINT :
     PRINT
580  FOR X = 1 TO 7500:
     NEXT
590  GOTO 540
600  HOME
610  PRINT "TERRIFIC!!!!!"
615  FOR X = 1 TO 4000:
     NEXT
620  HOME
630  PRINT "AFTER 3T DAYS OF TIME HAVE PASSED HOW   MANY NUCLEI OF POLONIUM
      REMAIN?"
640  FOR X = 1 TO 7500:
     NEXT
650  INPUT "NUMBER=";M$
660  IF M$ = "N/8" THEN
         GOTO 695
670  PRINT "TRY AGAIN. HOPE YOU HAVE BETTER LUCK    THIS TIME."
680  FOR X = 1 TO 7500:
     NEXT
685  PRINT :
     PRINT
690  GOTO 630
```

```
695  HOME
696  PRINT "TERRIFIC!!!!!"
700  FOR X = 1 TO 4000:
     NEXT
710  HOME
720  INPUT "DO YOU WISH TO REPEAT THIS PROGRAM ON   HALF LIFE?(YES/NO)";Q$
730  IF  LEFT$ (Q$,1) = "Y" THEN

         GOTO 90
740  TEXT :
     HOME
     END


END OF LISTING

PROGRAM LENGTH: 116 LINES / 3267 BYTES
```

HELLO

This hello program is one that loads in my logo, which is a CAT (for Computer Assisted Teaching) from a B file which is in machine language and therefore not available to you. Create another logo and insert it in line 1. Then the program will load your logo and prepare the machine for the user by eventually bringing up your catalog to the screen.

```
  1  HGR :
     PRINT  CHR$ (4);"BLOAD CAT":
     HOME
  2  VTAB 22:
     PRINT "CREATED AT WESTERN HILLS HIGH SCHOOL":
     HTAB 7:
     PRINT "CINCINNATI PUBLIC SCHOOLS"
  3  FOR X = 1 TO 5000:
     NEXT
  5  TEXT
 10  HOME
 20  VTAB 6
 30  HTAB 14
 40  PRINT "1981 - 1983"
 50  PRINT :
     PRINT
 60  HTAB 16
 70  PRINT "PROGRAMS"
 80  PRINT
 90  HTAB 19:
     PRINT "BY"
100  PRINT :
     PRINT
110  HTAB 8
120  PRINT "DR. MARCELLINE A. BARRON"
130  PRINT
140  HTAB 16
150  PRINT "( ET AL )
190  VTAB 22
200  REM  --POKE LANGUAGE CARD FINDER
```

```
210  POKE 768,0:
     POKE 769,173:
     POKE 770,0:
     POKE 771,224:
     POKE 772,72:
     POKE 773,173:
     POKE 774,129:
     POKE 775,192:
     POKE 776,104:

220  POKE 777,72:
     POKE 778,205:
     POKE 779,0:
     POKE 780,224:
     POKE 781,208:
     POKE 782,35:
     POKE 783,173:
     POKE 784,131:
     POKE 785,192:

230  POKE 786,173:
     POKE 787,131:
     POKE 788,192:
     POKE 789,169:
     POKE 790,165:
     POKE 791,141:
     POKE 792,0:

      POKE 793,208:
      POKE 794,205:

240  POKE 795,0:
     POKE 796,208:
     POKE 797,208:
     POKE 798,19:
     POKE 799,74:
     POKE 800,141:
     POKE 801,0:
     POKE 802,208:
     POKE 803,205:

250  POKE 804,0:
     POKE 805,208:
     POKE 806,208:
     POKE 807,10:
     POKE 808,173:
     POKE 809,129:
     POKE 810,192:
     POKE 811,173:
     POKE 812,129:
```

```
260  POKE 813,192:
     POKE 814,169:
     POKE 815,1:
     POKE 816,208:
     POKE 817,2:
     POKE 818,169:
     POKE 819,0:
     POKE 820,141:
     POKE 821,0:

270  POKE 822,3:
     POKE 823,104:
     POKE 824,205:
     POKE 825,0:
     POKE 826,224:
     POKE 827,240:
     POKE 828,3:
     POKE 829,173:
     POKE 830,128:

280  POKE 831,192:
     POKE 832,96:

290  CALL 769
300  IF  PEEK (768) <  > 1 THEN
         400
310  REM
320  REM --IF THERE, LOAD INTG AND PA#1
330  REM
340  PRINT " (LOADING INTEGER INTO LANGUAGE CARD)"
350  PRINT "BLOAD INTBASIC,A$D000"
360  REM  --WRITE PROTECT THE CARD
370  LET A =  PEEK ( - 16254):
     REM   $C082
375  PRINT :

     PRINT :
     PRINT
376  PRINT  CHR$ (4);"CATALOG"
380  NEW
390  END
400  REM
410  REM --NO CARD OR CAN'T RELOAD
420  REM
430  IF  PEEK (768) = 0 THEN
         END
440  PRINT :
     PRINT "...LANGUAGE CARD CANNOT BE RELOADED":
     PRINT "   UNTIL THE SYSTEM IS REBOOTED..."
450  END

END OF LISTING

PROGRAM LENGTH: 48 LINES / 1329 BYTES
```

HELLO-1

Hello-1 is a file distribution program. It takes over after the student runs a program and does not introduce the student to Apple II+ as HELLO-* does. It helps the student use the AppleII+ without knowing commands.

```
 10  REM  *** APPLE BASIC PROGRAM LIBRARY
 20  REM
 30  REM   NAME: HELLO-1
 40  REM
 50  REM  WRITTEN BY:    TROY OWENS
 60  REM
 70  REM  DATE:   08/13/81
 80  REM
100  REM  THIS PROGRAM IS DESIGNED TO BE USED AFTER THE CURRENT
          PROGRAM HAS ENDED
110  REM  AGAIN IT IS TO HELP THE STUDENT OPERATE THE APPLE II
120  REM
130  REM ****************************************
140  REM   PASSWORD  'CTRL ALLOW'
150  REM ****************************************
160  REM
170  DIM N$(30),P$(30)
180  LET D$ =  CHR$ (4)
190  LET R$ = "RUN"
200  TEXT :
     HOME
210  HTAB 17:
     PRINT "APPLE II"
220  VTAB 8
230  HTAB 8:
     PRINT "*************************"
240  PRINT
250  HTAB 10:
     PRINT "HERE ARE THE PROGRAMS"
260  PRINT
270  HTAB 14:
     PRINT "ON THIS  DISK"
280  PRINT
290  HTAB 15:
     PRINT "YOU CAN RUN"
300  PRINT
310  HTAB 8:
     PRINT "*************************"
320  FOR I = 1 TO 5000:
     NEXT
330  HOME
340  HTAB 17:
     INVERSE :
     PRINT "CATALOG":
     NORMAL
350  PRINT D$;"CATALOG"
360  PRINT
```

```
370  PRINT "TYPE IN THE NAME OF THE PROGRAM YOU WANT"
380  PRINT "('N'=STOP)"
390  PRINT
400  INPUT "WHAT PROGRAM DO YOU WANT? ";P$
410  IF P$ = "N" THEN
          430
420  GOTO 480
430  INPUT "PASSWORD? ";Z$
435  REM  BETWEEN "" THERE ARE 5 CTRL CHARACTERS 'CRTL ALLOW'
440  IF Z$ = "


               " THEN


          HOME :
          END
450  PRINT
460  PRINT "INCORRECT PASSWORD."
470  FOR I = 1 TO 1500:
     NEXT :
     GOTO 330
480  HOME
490  ONERR  GOTO 510
500  PRINT D$,R$,P$
510  HOME
520  VTAB 8
530  HTAB 13:
     INVERSE :
     PRINT "NO SUCH PROGRAM":
     NORMAL
535  REM  BETWEEN   "" THERE ARE  2 CTRL CHARACTERS  'CTRL G,CTRLG'
540  PRINT ""
550  FOR I = 1 TO 3000:
     NEXT
560  GOTO 330


END OF LISTING

PROGRAM LENGTH: 57 LINES / 1198 BYTES
```

HELLO-*

Hello-* is a file distribution program that takes control away from the student and helps the students run the Apple II+ without knowing any commands.

```
 10  REM  ****** APPLE BASIC PROGRAM LIBRARY
 20  REM
 30  REM  NAME:  HELLO
 40  REM
 50  REM  WRITTEN BY: TROY OWENS
 60  REM
 70  REM  DATE:    08/13/81
 80  REM  THIS PROGRAM IS DESIGNED TO HELP THE STUDENT OPERATE THE APPLE II
 90  REM  THE PROGRAM TAKES CARE OF ALL DOS COMMANDS FOR YOU
100  REM  THE PURPOSE FOR THIS PROGRAM IS TO MAKE THE OPERATION OF THE COMP
     UTER AS SIMPLE AS POSSIBLE FOR THE STUDENTS
110  REM
120  REM  THIS PROGRAM DOES NOT ALLOW THE STUDENT ACCESS TO THE OPERATION C
     OMMANDS OF THE COMPUTER UNLESS THEY HAVE THE CORRECT PASSWORD
130  REM
140  REM ****************************************
150  REM   PASSWORD: 'CTRL ALLOW'
160  REM ****************************************
170  HOME
180  PRINT "PLEASE WAIT ONE MOMENT."
190  REM  --POKE LANGUAGE CARD FINDER
200  POKE 768,0:
     POKE 769,173:
     POKE 770,0:
     POKE 771,224:
     POKE 772,72:
     POKE 773,173:
     POKE 774,129:
     POKE 775,192:
     POKE 776,104:

210  POKE 777,72:
     POKE 778,205:
     POKE 779,0:
     POKE 780,224:
     POKE 781,208:
     POKE 782,35:
     POKE 783,173:
     POKE 784,131:
     POKE 785,192:
```

```
220  POKE 786,173:
     POKE 787,131:
     POKE 788,192:
     POKE 789,169:
     POKE 790,165:
     POKE 791,141:
     POKE 792,0:
     POKE 793,208:
     POKE 794,205:

230  POKE 795,0:
     POKE 796,208:
     POKE 797,208:
     POKE 798,19:
     POKE 799,74:
     POKE 800,141:
     POKE 801,0:
     POKE 802,208:
     POKE 803,205:

240  POKE 804,0:
     POKE 805,208:
     POKE 806,208:
     POKE 807,10:
     POKE 808,173:
     POKE 809,129:
     POKE 810,192:
     POKE 811,173:
     POKE 812,129:

250  POKE 813,192:
     POKE 814,169:
     POKE 815,1:
     POKE 816,208:
     POKE 817,2:
     POKE 818,169:
     POKE 819,0:
     POKE 820,141:
     POKE 821,0:

260  POKE 822,3:
     POKE 823,104:
     POKE 824,205:
     POKE 825,0:
     POKE 826,224:
     POKE 827,240:
     POKE 828,3:
     POKE 829,173:
     POKE 830,128:

270  POKE 831,192:
     POKE 832,96:
```

```
280  CALL 769
290  IF  PEEK (768) <  > 1 THEN
         370
300  REM
310  REM --IF THERE, LOAD INTG AND PA#1
320  REM
330  PRINT "BLOAD INTBASIC,A$D000"
340  REM  --WRITE PROTECT THE CARD
350  LET A =  PEEK ( - 16254):
     REM   $C082
360  DIM N$(30),P$(30)
370  LET D$ =  CHR$ (4)
380  LET R$ = "RUN"
390  TEXT :
     HOME
400  VTAB 5
410  PRINT "HH    HH EEEEEEE LL       LL       0000000"
420  PRINT "HH    HH EE       LL       LL      00    00"
430  PRINT "HH    HH EE       LL       LL      00    00"
440  PRINT "HHHHHHH EEEEE    LL       LL      00    00"
450  PRINT "HH    HH EE       LL       LL      00    00"
460  PRINT "HH    HH EE       LL       LL      00    00"
470  PRINT "HH    HH EEEEEEE LLLLLLL LLLLLLL 0000000"
480  PRINT "                                         "
490  VTAB 13
500  INPUT "WHAT IS YOUR NAME? ";N$
510  IF N$ = "" THEN
         490
520  PRINT
530  PRINT "HI! "N$" MY NAME IS CRAIG."
540  VTAB 17
550  PRINT "WOULD YOU LIKE TO SEE THE CATALOG OF"
560  INPUT "PROGRAMS THAT YOU CAN RUN (YES/NO)? ";Z$
570  IF Z$ = "NO" THEN
         390
580  IF Z$ = "YES" THEN
         600
590  GOTO 540
600  TEXT :
     HOME
610  HTAB 17:
     PRINT "APPLE II"
620  VTAB 8
630  HTAB 8:
     PRINT "**************************"
640  PRINT
650  HTAB 10:
     PRINT "HERE ARE THE PROGRAMS"
660  PRINT
670  HTAB 14:
     PRINT "ON THIS  DISK"
680  PRINT
```

```
690  HTAB 15:
     PRINT "YOU CAN RUN"
700  PRINT
710  HTAB 8:
     PRINT "*************************"
720  FOR I = 1 TO 5000:
     NEXT
730  HOME
740  HTAB 17:
     INVERSE :
     PRINT "CATALOG":
     NORMAL
750  PRINT D$;"CATALOG"
760  PRINT
770  PRINT "TYPE IN THE NAME OF THE PROGRAM YOU WANT"
780  PRINT "('N'=STOP)"
790  PRINT
800  INPUT "WHAT PROGRAM DO YOU WANT? ";P$
810  IF P$ = "N" THEN
          830
820  GOTO 890
830  INPUT "PASSWORD? ";Z$
840  REM  BETWEEN "" THERE ARE 5 CTRL CHARACTERS    'CTRL ALLOW'
850  IF Z$ = "

                " THEN
          HOME :
          END
860  PRINT
870  PRINT "INCORRECT PASSWORD."
880  FOR I = 1 TO 1500:
     NEXT :
     GOTO 730
890  HOME
900  ONERR  GOTO 920
910  PRINT D$,R$,P$
920  HOME
930  VTAB 8
940  HTAB 13:
     INVERSE :
     PRINT "NO SUCH PROGRAM":
     NORMAL
950  PRINT ""
960  FOR I = 1 TO 3000:
     NEXT
970  GOTO 730

END OF LISTING

PROGRAM LENGTH: 97 LINES / 2830 BYTES
```

HGR

This program creates a graphing grid with the X and Y axes marked in high resolution graphics.

Data Input

(a) choice for plotting points or plotting lines

(b) X-coordinate values; Y-coordinate values

(c) length of line desired

Results Returned

(a) individually plotted points in any of the four quadrants

(b) lines of any slope plotted in all four quadrants

Limitations

(a) choices of X & Y must be between 0 and 280, which are the limits of the graphics screen.

(b) the 0,0 point for the graphics screen is in the upper left corner

```
 10  HGR
 15  HOME
 20  HCOLOR= 6
 25  LET Y = 0
 30  FOR X = 1 TO 39
 40      HPLOT 0,Y TO 270,Y
 50      LET Y = Y + 5
 60  NEXT
 70  LET X = 0
 80  FOR Y = 1 TO 55
 90      HPLOT X,0 TO X,190
100      LET X = X + 5
110  NEXT
115  HCOLOR= 5
120  HPLOT 135,0 TO 135,159
130  HPLOT 0,80 TO 270,80
135  GOSUB 3000
136  HCOLOR= 5
140  INPUT "ENTER 1 FOR POINTS, ENTER 2 FOR LINES ";A$
150  IF  VAL (A$) = 1 THEN
         200
160  IF  VAL (A$) = 2 THEN
         1000
```

HGR-2 GRAPH

This program displays the total graphics screen in a grid form which is available on the Apple computer if no text is needed. Text can be placed on this grid using shape tables. It allows the viewer to see the actual size of the graphics screen. This program is in high resolution graphics.

```
 10  HGR2
 20  HCOLOR= 3
 25  LET Y = 0
 30  FOR X = 1 TO 39
 40      HPLOT 0,Y TO 270,Y
 50      LET Y = Y + 5
 60  NEXT
 70  LET X = 0
 80  FOR Y = 1 TO 55
 90      HPLOT X,0 TO X,190
100      LET X = X + 5
110  NEXT
```

END OF LISTING

PROGRAM LENGTH: 12 LINES / 116 BYTES

HGR-2 GRAPH

This program displays the total graphics screen in a grid form which is available on the Apple computer if no text is needed. Text can be placed on this grid using shape tables. It allows the viewer to see the actual size of the graphics screen. This program is in high resolution graphics.

```
 10  HGR2
 20  HCOLOR= 3
 25  LET Y = 0
 30  FOR X = 1 TO 39
 40      HPLOT 0,Y TO 270,Y
 50      LET Y = Y + 5
 60  NEXT
 70  LET X = 0
 80  FOR Y = 1 TO 55
 90      HPLOT X,0 TO X,190
100      LET X = X + 5
110  NEXT
```

END OF LISTING

PROGRAM LENGTH: 12 LINES / 116 BYTES

```
 170  GOTO 135
 200  GOSUB 3000:
      INPUT "ENTER 'X' COORDINATE ?";X$
 225  GOSUB 3010
 230  INPUT "ENTER 'Y' COORDINATE ?";Y$
 235  IF  VAL (Y$) >  ABS (80) THEN
          225
 240  LET Y =  VAL (Y$) + 80:
      LET Y =  ABS (Y - 159)
 245  LET X =  VAL (X$) + 135
 250  HPLOT X,Y
 260  GOTO 200
 990  HCOLOR= 13
1000  INPUT "ENTER 'X' COORDINATE FOR LINE";T$
1100  INPUT "ENTER 'Y' COORDINATE FOR LINE";R$
1200  INPUT "ENTER SECOND 'X' COORDINATE";E$
1225  PRINT
1227  INPUT "ENTER SECOND 'Y' COORDINATE";G$
1270  GOTO 1400
1400  LET X =  VAL (T$) + 135
1450  LET Y =  VAL (R$) + 80
1460  LET E =  VAL (E$) + 135
1470  LET G =  VAL (G$) + 80
1500  HPLOT X,Y TO E,G
1520  GOTO 115
3000  VTAB 21:
      PRINT "
                    ":
      VTAB 21:
      RETURN
3010  VTAB 22:
      PRINT "                                    ":
      VTAB 22:
      RETURN


END OF LISTING

PROGRAM LENGTH: 45 LINES / 845 BYTES
```

IDEAL GAS LAW

This program is based on the simple gas law formula of P(1)*V(1)/T(1) = P(2)*V(2)/T(2) with which the student can compute any variable, given all of the other five. In this program the student is asked which variable her or she wishes to compute: final temperature, final volume, or final pressure. Also the program calls up two graphics programs which are printed elsewhere in this document--GAS/GRAF and GAS/GRAF2.

```
 1  REM  IDEAL GASLAW
 2  REM  D.C. & J.K.
 3  REM  12-82
 4  TEXT :
    HOME
 5  LET A$ = "IDEAL GAS LAW":
    LET B$ = "BY":
    LET C$ = "BRUTE FORCE CYBERNETICS"
 6  VTAB 6:
    HTAB 13
10  FOR C = 1 TO  LEN (A$)
11      LET D$ =  MID$ (A$,C,1)
12      INVERSE :
        PRINT D$;:
        PRINT  CHR$ (7);:
    NEXT C
13  VTAB 8:
    HTAB 18
15  FOR C = 1 TO  LEN (B$)
16      LET E$ =  MID$ (B$,C,1)
17      PRINT E$;:
        PRINT  CHR$ (7);:
    NEXT C
20  VTAB 10:
    HTAB 8
25  FOR C = 1 TO  LEN (C$)
30      LET F$ =  MID$ (C$,C,1)
31      PRINT F$;:
        PRINT  CHR$ (7);:
    NEXT C
32  NORMAL
35  FOR B = 1 TO 2500:
    NEXT B
40  HOME
```

```
 50  INVERSE :
     HTAB 13:
     PRINT "IDEAL GAS LAW":
     NORMAL
 60  VTAB 5:
     HTAB 09:
     PRINT "(P1*V1)/T1=(P2*V2)/T2"
 70  VTAB 7:
     PRINT "DO YOU WANT TO FIND:"
 80  VTAB 9:
     HTAB 2:
     PRINT "1. FINAL TEMPERATURE"
 90  VTAB 11:
     HTAB 2:
     PRINT "2. FINAL VOLUME"
100  VTAB 13:
     HTAB 2:
     PRINT "3. FINAL PRESSURE"
105  VTAB 15:
     HTAB 2:
     PRINT "4. EXIT PROGRAM"
110  VTAB 17:
     HTAB 2:
     PRINT "5. SEE GRAPH
115  VTAB 19:
     INPUT "WHICH ONE?";C
120  IF C < 1 OR C > 5 THEN
         PRINT "TRY AGAIN":
         GOTO 110
130  ON C GOTO 200,800,500,1000,1200
200  HOME
210  INVERSE :
     HTAB 11:
     PRINT "FINAL TEMPERATURE":
     NORMAL
220  VTAB 3:
     INPUT "WHAT IS THE INITIAL TEMP?";D
230  VTAB 5:
     INPUT "WHAT IS THE INITIAL VOLUME?";E
240  VTAB 7:
     INPUT "WHAT IS THE INITIAL PRESSURE?";F
250  VTAB 9:
     INPUT "WHAT IS THE FINAL VOLUME?";G
260  VTAB 11:
     INPUT "WHAT IS THE FINAL PRESSURE?";H
270  LET I = ((H * G) * (D + 273)) / (F * E)
280  VTAB 13:
     PRINT "FINAL TEMPERATURE=";I;" KELVIN"
290  GOSUB 2000
300  GOTO 200
310  END
500  HOME
```

```
510  HTAB 13:
     INVERSE :
     PRINT "FINAL PRESSURE":
     NORMAL
520  VTAB 3:
     INPUT "WHAT IS THE INITIAL PRESSURE?";J
530  VTAB 5:
     INPUT "WHAT IS THE INITIAL VOLUME?";K
540  VTAB 7:
     INPUT "WHAT IS THE INITIAL TEMPERATURE?";L
550  VTAB 9:
     INPUT "WHAT IS THE FINAL VOLUME?";M
560  VTAB 11:
     INPUT "WHAT IS THE FINAL TEMPERATURE?";N
570  LET O = ((J * K) * (N + 273)) / ((L + 273) * M)
580  VTAB 13:
     PRINT "FINAL PRESSURE=";O
590  GOSUB 2000
600  GOTO 500
610  END
800  HOME
810  HTAB 14:
     INVERSE :
     PRINT "FINAL VOLUME":
     NORMAL
820  VTAB 3:
     INPUT "WHAT IS THE INITIAL VOLUME?";P
830  VTAB 5:
     INPUT "WHAT IS THE INITIAL PRESSURE?";Q

840  VTAB 7:
     INPUT "WHAT IS THE INITIAL TEMP?";R
850  VTAB 9:
     INPUT "WHAT IS THE FINAL PRESSURE?";S
860  VTAB 11:
     INPUT "WHAT IS THE FINAL TEMP?";T
870  LET U = ((Q * P) * (T + 273)) / ((R + 273) * (S))
880  VTAB 13:
     PRINT "FINAL VOLUME=";U
890  GOSUB 2000
900  GOTO 800
910  END
1000 HOME
1010 VTAB 12:
     PRINT "THANK YOU!!!!!!!!!!!!"
1020 END
1200 HOME
1210 PRINT  CHR$ (4)"RUN GAS/GRAF"
```

```
2000  VTAB 21:
      HTAB 4:
      PRINT "DO YOU WHAT ANOTHER CALCULATION?"
2010  GET A$
2020  IF A$ = "N" THEN
          40
2030  RETURN


END OF LISTING

PROGRAM LENGTH: 76 LINES / 1805 BYTES
```

INCLINED PLANE

This program will compute average acceleration of an object (marble or dynamics cart) down an inclined plane.

Data Input

(a) number of trials to be averaged

(b) angle of incline to horizontal in degrees

(c)distance (in centimeters) and time (in seconds) for each trial

Results Returned

(a) complete listing of data used with trial number

(b) average experimental acceleration

(c) theoretical acceleration computed for given angle

Works best with marble in shallow grooved trace (2 meters) with angles between five and thirty degress.

Recommend five trials of varying distance for each angle with repetitions for three or four angles.

```
 1  HOME
 5  HIMEM: 8164
 6  POKE 232,0:
    POKE 233,64
10  HGR :
    HCOLOR= 3:
    SCALE= 1
15  ROT= 0
20  PRINT  CHR$ (4);"BLOAD IN ,A$4000"
30  DRAW 1 AT 150,99
35  LET H = 9
40  FOR A = 0 TO 50
45      LET B = 150 - 3 * A
49      XDRAW H AT B,99 + A
50      XDRAW 2 AT B,99 + A
51      IF A = 50 THEN
            70
55      XDRAW 2 AT B,99 + A
56      XDRAW H AT B,99 + A
59      LET H = H + 1:
        IF H = 15 THEN
            LET H = 9
```

```
 60  NEXT
 70  VTAB 22
 90  TEXT :
     HOME
100  INPUT "NUMBER OF OBSERVATIONS?  ";N
103  DIM D(N),T(N)
105  PRINT :
     PRINT
110  INPUT "WHAT ANGLE WAS USED?     ";ANG
115  PRINT :
     PRINT
120  LET ANG = ANG / 57.3
130  PRINT "FOR EACH TRIAL,"
140  PRINT "GIVE THE DISTANCE AND TIME:"
145  PRINT :
     PRINT
150  FOR J = 1 TO N
155      PRINT "TRIAL #";J
160      INPUT "  DISTANCE (CM) = ";D(J)
165      INPUT "  TIME (SEC)    = ";T(J)
166      PRINT
170      LET D = D(J)
180      LET T = T(J)
190      LET A = 2 * D / (T ^ 2)
200      LET A(J) = A
210  NEXT J
220  HOME
230  PRINT "RESULTS FOR YOUR TRIALS:"
235  PRINT
240  FOR J = 1 TO N
250      PRINT "  DISTANCE = ";D(J);"  TIME = ";T(J)
255      PRINT
260  NEXT J
270  LET TT = 0
280  FOR J = 1 TO N
290      LET TT = TT + A(J)
300  NEXT J
310  LET AVE = TT / N
320  LET AG = 980 *  SIN (ANG)
325  PRINT :
     PRINT :
     PRINT
330  PRINT "ACCELERATION UNITS = CM/SEC^2"
335  PRINT
340  PRINT "AVERAGE ACCELERATION     = ";AVE
350  PRINT "THEORETICAL ACCELERATION = ";AG


END OF LISTING

PROGRAM LENGTH: 56 LINES / 895 BYTES
```

INVENTORY

The program, Inventory, is one that helps the user keep track of a supply of any types of items. This generic program allows the user to create a new inventory, to display the inventory, to delete items, to edit an item's data, amd to add new items to the existing inventory. It creates text files in which the data is stored.

```
 10  REM  *****************
 20  REM   **INVENTORY    **
 30  REM  **BY J KRUSLING**
 40  REM  **APRIL 1983    **
 50  REM  *****************
 51  REM
 52  REM  UPDATED 9/8/83
 55  REM
 56  GOSUB 5000
 60  DIM ID$(255),LO$(255),SN$(255),CO$(255)
 70  GOSUB 1300
 80  HOME
 85  IF K > 0 THEN
         PR# 0
 90  VTAB 2:
     HTAB 15:
     INVERSE :
     PRINT "INVENTORY":
     NORMAL
100  VTAB 6:
     HTAB 2:
     PRINT "1) CREATE NEW INVENTORY.
110  VTAB 8:
     HTAB 2:
     PRINT "2) DISPLAY INVENTORY."
120  VTAB 10:
     HTAB 2:
     PRINT "3) DELETE AN ITEM."
130  VTAB 12:
     HTAB 2:
     PRINT "4) EDIT AN ITEM'S DATA."
140  VTAB 14:
     HTAB 2:
     PRINT "5) ADD TO EXISTING INVENTORY."
150  VTAB 16:
     HTAB 2:
     PRINT "6) EXIT THIS  PROGRAM."
155  VTAB 18:
     HTAB 2:
     PRINT "7) PRINTER OPTION."
```

```
160  VTAB 21:
     HTAB 2:
     INPUT "YOUR SELECTION: ";A
170  IF A < 1 OR A > 7 THEN
         160
180  ON A GOTO 310,470,640,870,1160,185,7000
185  REM   **END PROGRAM SAVE FILES**
190  HOME :
     LET D$ =  CHR$ (4)
200  PRINT D$;"OPEN INVEN/TXT"
210  PRINT D$;"DELETE INVEN/TXT"
220  PRINT D$;"OPEN INVEN/TXT"
230  PRINT D$;"WRITE INVEN/TXT"
240  LET B = 1
250  PRINT ID$(B):
     PRINT LO$(B):
     PRINT SN$(B):

     PRINT CO$(B)
260  IF ID$(B) = "END" THEN
         290
270  LET B = B + 1
280  GOTO 250
290  PRINT D$;"CLOSE INVEN/TXT"
300  END
310  REM  **CREATE A FILE**
320  LET B = 1
330  HOME
340  HTAB 7
350  PRINT "TYPE ";:
     INVERSE :
     PRINT "END";:
     NORMAL :
     PRINT " TO RETURN TO MENU "
360  VTAB 6
370  PRINT "ITEM NAME OR DESCRIPTION AND QUANTITY.":
     INPUT "ITEM(BRAND)/QUANTITY : ";ID$(B)
380  IF ID$(B) = "END" THEN
         430
390  VTAB 9:
     INPUT "LOCATION : ";LO$(B)
400  VTAB 11:
     INPUT "ID (SERIAL) NO./CONDITION : ";SN$(B)
405  VTAB 13:
     INPUT "COST : $";CO$(B)
410  LET B = B + 1
420  GOTO 330
430  LET LO$(B) = "END"
440  LET SN$(B) = "END"
445  LET CO$(B) = "END"
450  GOTO 80
460  REM  **DISPLAY INVENTORY**
470  LET N = 1
480  HOME
```

```
490  IF ID$(N) = "END" THEN
         630
495  IF K > 0 THEN
         GOSUB 6000
500  INVERSE :
     PRINT "ITEM/QUANTIY:":
     NORMAL
510  PRINT ID$(N):
     PRINT
520  INVERSE :
     PRINT "LOCATION:":
     NORMAL
530  PRINT LO$(N)
540  PRINT
550  INVERSE :
     PRINT "ID (SERIAL) NO./CONDITION:":
     NORMAL
560  PRINT SN$(N)
564  PRINT :
     INVERSE :
     PRINT "COST:":
     NORMAL :
     PRINT "$"CO$(N)
565  IF OP THEN
         610
570  VTAB 22
580  HTAB 7
590  PRINT "PRESS ANY KEY TO CONTINUE"
600  GET A$:
     IF A$ = "" THEN
         600
610  LET N = N + 1
620  GOTO 480
630  PR# 0:
     GOTO 80
640  REM   **SUB TO DELETE ITEMS**
650  HOME
660  PRINT "NAME OF ITEM YOU WISH TO BE DELETED OR":
     INPUT "TYPE 'L' TO SEE A LIST OF ITEMS ";A$
670  IF A$ = "L" THEN
         GOSUB 1080:
         GOTO 660
680  FOR B = 1 TO N
690      IF A$ = ID$(B) THEN
             760
700  NEXT
710  HOME
720  PRINT "THAT'S NOT AN ITEM IN THIS INVENTORY"
730  VTAB 22:
     PRINT "PRESS ANY KEY TO CONTINUE"
740  GET A$:
     IF A$ = "" THEN
         740
```

```
750  GOTO 640
760  HOME
770  PRINT "ARE YOU SURE YOU WANT TO DELETE":
     PRINT ID$(B);
780  GET Z$:
     IF Z$ <  > "Y" THEN
          80
790  FOR C = B TO N - 1
800       LET H$(C) = ID$(C):
          LET ID$(C) = ID$(C + 1):
          LET ID$(C + 1) = H$(C)
810       LET K$(C) = LO$(C):
          LET LO$(C) = LO$(C + 1):
          LET LO$(C + 1) = K$(C)
820       LET J$(C) = SN$(C):
          LET SN$(C) = SN$(C + 1):
          LET SN$(C + 1) = J$(C)
825       LET V$(C) = CO$(C):
          LET CO$(C) = CO$(C + 1):
          LET CO$(C + 1) = V$(C)
830  NEXT C
840  LET ID$(N) = "":
     LET LO$(N) = ""
850  LET SN$(N) = "":
     LET CO$(N) = ""
860  GOTO 80
870  REM     **EDIT ITEM DATA**

880  REM
890  HOME
900  VTAB 4
910  PRINT "ENTER THE NAME OF THE ITEM YOU WISH TO"
920  INPUT "EDIT OR 'L' TO LIST ITEMS ";N$
930  IF N$ = "L" THEN
          GOSUB 1080:
          GOTO 910
940  FOR B = 1 TO N
950       IF N$ = ID$(B) THEN
               1000
960  NEXT
970  HOME :
     PRINT "THAT'S NOT AN ITEM IN THIS INVENTORY":
     VTAB 22:
     PRINT  TAB( 7)"PRESS ANY KEY TO CONTINUE"
980  GET A$:
     IF A$ = "" THEN
          980
990  GOTO 870
1000 HOME
1010 VTAB 4:
     PRINT "ITEM(BRAND)/QUANTITY: ";ID$(B)
1020 VTAB 6:
     PRINT "LOCATION: ";LO$(B)
```

```
        1200
1190  LET B = B + 1:
      GOTO 1160
1200  LET N = B
1210  HOME
1220  HTAB 5:
      PRINT "TYPE ";:
      INVERSE :
      PRINT "END";:
      NORMAL :
      PRINT " TO RETURN TO THE MENU"
1230  VTAB 4:
      PRINT "ITEM NAME OR DESCRIPTION AND QUANTITY":
      INPUT "ITEM(BRAND)/QUANTITY: ";ID$(N)
1240  IF ID$(N) = "END" THEN
          LET LO$(N) = "END":
          LET SN$(N) = "END":
          LET CO$(N) = "END":
          GOTO 80
1250  PRINT :
      INPUT "LOCATION: ";LO$(N)
1030  VTAB 8:
      PRINT "ID (SERIAL) NO./CONDITION: ";SN$(B)
1035  VTAB 10:
      PRINT "COST: $";CO$(B)
1040  VTAB 12:
      PRINT "+++++++++++++++CORRECTIONS+++++++++++++++"
1045  VTAB 14:
      INPUT "ITEM(BRAND)/QUANTITY: ";ID$(B)
1050  VTAB 16:
      INPUT "LOCATION: ";LO$(B)
1060  VTAB 18:
      INPUT "ID (SERIAL) NO./CONDITION: ";SN$(B)
1065  VTAB 20:
      INPUT "COST: $";CO$(B)
1070  GOTO 80
1080  HOME :
      VTAB 1:
      PRINT "PRESS 'SPACEBAR' TO STOP THE LISTING"
1090  PRINT
1100  FOR B = 1 TO N - 1
1110      PRINT ID$(B):
          PRINT
1120      LET Q =  PEEK ( - 16384):
          IF Q = 160 THEN
              POKE  - 16368,0:
              GOTO 1150
1130      FOR T = 1 TO 500:
          NEXT
1140  NEXT
1150  RETURN
1160  REM  **SUB TO ADD ITEMS**
1170  LET B = 1
1180  IF ID$(B) = "END" THEN
```

```
1260  PRINT :
      INPUT "ID (SERIAL) NO./CONDITION: ";SN$(N)
1265  PRINT :
      INPUT "COST: $";CO$(N)
1270  LET N = N + 1
1280  GOTO 1210
1290  REM  **SUB TO LOAD DATA**
1300  REM
1310  LET D$ =  CHR$ (4)
1320  LET B = 1
1330  PRINT D$;"OPEN INVEN/TXT"
1340  PRINT D$;"READ INVEN/TXT"
1350  INPUT ID$(B),LO$(B),SN$(B),CO$(B)
1360  IF ID$(B) = "END" THEN
          1390
1370  LET B = B + 1
1380  GOTO 1350
1390  LET N = B
1400  PRINT D$;"CLOSE INVEN/TXT"
1410  RETURN
5000  REM  **TITLE PAGE**
5010  HOME
5020  VTAB 9:
      HTAB 15:
      INVERSE :
      PRINT "INVENTORY":
      NORMAL
5030  VTAB 11:
      HTAB 13:
      PRINT "BY J KRUSLING"
5040  VTAB 13:
      HTAB 15:
      PRINT "MAY 1983"
5050  FOR T = 1 TO 2100:
      NEXT
5060  RETURN
6000  REM  OUTPUT TO PRINTER

6005  IF PT ) 1 THEN
          6020
6010  PR# 1:
      PRINT  CHR$ (9)"80N" CHR$ (13):
      PRINT  CHR$ (9)"3P" CHR$ (13):
      PRINT  CHR$ (9)"1D" CHR$ (13)
6020  IF PT ) 1 THEN
          PR# 1
6030  RETURN
7000  REM  ** PRINTER ON **
7010  HOME :
      HTAB 10:
      PRINT "PRINTER STATUS"
7020  IF PT ) 0 THEN
          7080
```

```
7030  PRINT :
      PRINT "ARE YOU USING:"
7040  PRINT :
      PRINT "A.  A DECWRITER?":
      PRINT :
      PRINT "B.  AN EPSON OR APPLE PRINTER?":
      PRINT :
      INPUT "CHOICE:";AN$
7050  IF AN$ < "A" OR AN$ > "B" THEN
          7030
7060  IF AN$ = "A" THEN
          LET PT = 1
7070  IF AN$ = "B" THEN
          LET PT = 2
7080  PRINT :
      PRINT "THE PRINTER IS NOW ";
7090  IF K < 1 THEN
          PRINT "OFF."
7100  IF K >  = 1 THEN
          PRINT "ON."
7110  PRINT :
      INPUT "DO YOU WANT TO CHANGE THIS?";AN$
7120  IF AN$ = "N" OR AN$ = "NO" THEN
          7160
7130  IF K > 0 THEN
          LET K = 0
7140  IF K < 1 THEN
          LET K = PT
7150  PRINT :
      PRINT "DONE."
7160  FOR S = 1 TO 1000:
      NEXT S:
      GOTO 80
```

END OF LISTING

PROGRAM LENGTH: 187 LINES / 4323 BYTES

LENSMIR

This program will compute distance of image from lens or mirror and height of image then graphically illustrates position of object, optical element and image generated with ray tracing technique.

Data Imput

(a) type of optical element:lens or mirror

(b) curvature: convex or concave

(c) focal length for lens (in cm)

(d) if mirror, state if focal length or radius of curvature then value of same

(e) position of object from element and height of object (cm) (consider limitations of graphing capabilities)

Results Returned

(a) position and height of image (cm)

(b) graphical display of ray tracing technique

Limitations: Element is located at coordinate (140,80). Object too close to focal point of convex lens or concave mirror will produce image beyond edge of graph resulting in error message. Same result is obtained if image size exceeds graph dimensions. Select a convenient scale factor to return image to graphing spaces.

```
50  TEXT :
    HOME
55  PRINT "              LENSMIR"
56  PRINT :
    PRINT :
    PRINT :
    PRINT :
    PRINT
60  PRINT "THIS PROGRAM WILL COMPUTE THE DISTANCE  OF THE IMAGE FROM A LEN
    S OR MIRROR."
61  PRINT :
    PRINT :
    PRINT
```

```
 62  PRINT "THE HEIGHT OF THE OBJECT NEEDS TO BE    KNOWN AS A PIECE OF INP
     UT DATA."
 63  PRINT :
     PRINT :
     PRINT :
     PRINT
 65  PRINT "PRESS (RETURN) TO CONTINUE":
     GET A$
 66  HOME
 70  PRINT "IN ADDITION IT WILL GRAPHICALLY  ILLUS- TRATE THE POSITIONS OF
     THE OBJECT, THE  LENS OR MIRROR, AND THE IMAGE GENERATED."
 72  PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT :
     PRINT
 75  PRINT " PRESS (RETURN) TO CONTINUE":
     GET B$
 80  HOME
100  PRINT "LENS OR MIRROR?"
110  INPUT M$
120  IF M$ = "MIRROR" THEN
          250
130  PRINT "CONVEX OR CONCAVE?"
140  INPUT C$
150  PRINT "FOCAL LENGTH IN CM? (40-50)"
160  INPUT F
170  IF C$ = "CONCAVE" THEN
          190
180  GOTO 200
190  LET F =  - F
200  GOTO 500
250  PRINT "CONVEX OR CONCAVE?"
260  INPUT C$
270  PRINT "FOCAL LENGTH (FL) OR RADIUS OF CURVATURE (RC)? RANGE OF 40-50."
280  INPUT Y$
290  IF Y$ = "RC" THEN
          320
300  PRINT "FOCAL LENGTH ? (CM)"
310  INPUT F
315  GOTO 350
320  PRINT "RADIUS OF CURVATURE (CM)?"
330  INPUT CEN
340  LET F = CEN / 2
350  IF C$ = "CONVEX" THEN
          370
360  GOTO 380
370  LET F =  - F
380  GOTO 500
500  PRINT "POSITION AND HEIGHT OF OBJECT IN CM?    RANGE FOR POSITION 60-8
     0; RANGE FOR     HEIGHT 10-15."
510  INPUT D,SD
```

```
520  IF D <  > F THEN
         550
530  PRINT "CANNOT CALCULATE INFINITE CASE"
540  GOTO 500
550  LET I = F * D / (D - F)
560  LET SI = SD * I / D
565  IF M$ = "MIRROR" THEN
         567
566  GOTO 570
567  LET I =  - I
570  VTAB (22)
580  PRINT "IMAGE POSITION AND HEIGHT:";I;" CM, ";SI;" CM."
700  HGR
710  HCOLOR= 1
720  HPLOT 0,80 TO 275,80
730  HCOLOR= 5
740  HPLOT 139,40 TO 139,120
750  HCOLOR= 3
760  HPLOT 140 - D,80 - SD TO 140 - D,80
770  HPLOT 140 - D,80 - SD TO 140 - D - 1,80 - SD + 2
780  HPLOT 140 - D,80 - SD TO 140 - D + 1,80 - SD + 2
790  HPLOT 140 - F,77 TO 140 - F,83
800  HPLOT 140 + F,77 TO 140 + F,83
801  IF M$ = "MIRROR" THEN
         1000
810  HCOLOR= 6
820  HPLOT 140 - D,80 - SD TO 140,80 - SD
830  HPLOT 140,80 - SD TO 140 + F,80
840  HPLOT 140 + F,80 TO 140 + I,80 + SI
850  HPLOT 140 - D,80 - SD TO 140,80
860  HPLOT 140,80 TO 140 + I,80 + SI
870  HCOLOR= 7
880  HPLOT 140 + I,80 + SI TO 140 + I,80
900  GOTO 1300
1000 HPLOT 140 - 2 * F,77 TO 140 - 2 * F,83
1010 HPLOT 140 + 2 * F,77 TO 140 + 2 * F,83
1011 IF C$ = "CONCAVE" THEN
         1016
1012 HCOLOR= 5
1013 HPLOT 135,75 TO 135,85
1014 HPLOT 137,60 TO 137,100
1015 GOTO 1020
1016 HPLOT 135,40 TO 135,45
1017 HPLOT 135,120 TO 135,115
1018 HPLOT 137,40 TO 137,60
1019 HPLOT 137,120 TO 137,100
1020 HCOLOR= 6
1030 HPLOT 140 - D,80 - SD TO 140,80 - SD
```

```
1040  HPLOT 140,80 -.SD TO 140 + I,80 + SI
1050  IF D = 2 * F THEN
          1110
1060  HPLOT 140,80 - SD TO 140 - F,80
1070  HPLOT 140 - 2 * F,80 TO 140 - D,80 - SD
1080  LET Y = 2 * F * SD / ((2 * F) - D)
1090  HPLOT 140 - D,80 - SD TO 140,80 - Y
1100  GOTO 1140
1110  HPLOT 140 - D,80 - SD TO 140,80 + SI
1120  HPLOT 140,80 + SI TO 140 + I,80 + SI
1130  GOTO 1150
1140  HPLOT 140,80 - Y TO 140 + I,80 + SI
1150  HCOLOR= 7
1160  HPLOT 140 + I,80 + SI TO 140 + I,80
1300  END


      END OF LISTING

      PROGRAM LENGTH: 99 LINES / 2155 BYTES
```

MARBLES; 2D COLLISIONS

(Conservation of Momemtun: A Collision in two Dimensions)

Investigation of conservation of momentum using two marbles moving off in different direction after they is illustrated in this program. Motion of incident marble produced by rolling down a ramp and projected from the edge of the lab table is discussed. Initially the range of the incident sphere is determined by laying a sheet of paper over carbon paper (carbon side up). Measure range from bottom of plumb line hanging at end of ramp to point of impact on floor (cm). From range and height of lab table, velocity is determined. Determine the average of several trials with marble starting at same point on the ramp. Mass of the marble should also be determined (in grams). Place a target marble off center at end of the ramp. Try several collisions with the incident marble starting from the same point on the ramp as in the initial trials. The range of each is determined along with the angle of the range vector from the initial range. The range represents the moment vectors of the two marbles.

Data Input

(a) range in original traial (cm)
(b) height of laboratory table (cm)
(c) masses of both marbles (incident, target) (in grams)
(d) range and angle of incident marble
(e) range and angle of target marble

Results Returned

(a) 1. original momentum (in gram-cm)
2. resultant momentum (in gram-cm)
3. original energy (in ergs)
4. final energy (in ergs)
5. energy difference (in ergs)

(b) 1. original momentum
2. resultant momentum
3. graphical representation of four momentum vectors
-original (white) (original range)
-incident marble (orange) (range of incident marble)
-target marble (green) (range of target marble)
-resultant (blue) (vector sum of ranges after collision)

```
 50  TEXT :
     HOME
100  INPUT "RANGE OF ORIGINAL TRIAL (CM):    ";Q
110  INPUT "HEIGHT OF TABLE (CM):            ";H
120  LET G = 980
130  LET T =  SQR (2 * H / G)
140  LET V = Q / T
150  PRINT "MASSES OF THE MARBLES (GRAMS)"
151  INPUT "  1ST MARBLE: ";MA
152  INPUT "  2ND MARBLE: ";MB
180  PRINT "RANGE AND ANGLE OF THE 1ST MARBLE AFTER          COLLISION:"
181  INPUT "  RANGE (CM): ";RA
182  INPUT "  DEGREES:    ";ALPH
190  PRINT "RANGE AND ANGLE OF THE 2ND MARBLE AFTER          COLLISION:"
191  INPUT "  RANGE (CM): ";RB
192  INPUT "  DEGREES:    ";BETA
220  LET R = 57.3
230  LET ALP = ALPH / R
240  LET BET = BETA / R
250  LET XA = RA *  COS (ALP)
260  LET YA =  - RA *  SIN (ALP)
270  LET XB = RB *  COS (BET)
280  LET YB = RB *  SIN (BET)
290  LET RX = XA + XB
300  LET RY = YA + YB
310  LET S =  SQR (RX ^ 2 + RY ^ 2)
320  LET VA = RA / T
322  LET VB = RB / T
324  LET D = (MA * V ^ 2) / 2
326  LET K = (MA * VA ^ 2) / 2
328  LET L = (MB * VB ^ 2) / 2
330  LET P = K + L
340  LET DM = MA * V
342  LET KM = MA * VA
344  LET LM = MB * VB
346  LET SC = DM / Q
348  LET PM = SC * S
350  HOME
352  PRINT "ORIGINAL MOMENTUM=  ";DM;" GRAM-CM"
354  PRINT "RESULTANT MOMENTUM=  ";PM;" GRAM-CM"
356  PRINT :
     PRINT
358  PRINT "ORIGINAL ENERGY=  ";D;"  ERGS"
360  PRINT "TOTAL FINAL ENERGY=  ";P;" ERGS"
362  LET Z = D - P
364  PRINT
366  PRINT "ENERGY LOST DURING COLLISION=  ";Z;" ERGS"
368  PRINT :
     PRINT :
     PRINT
```

```
370  PRINT "DO YOU WISH TO SEE THE GRAPHICAL RESULTS?(Y/N)"
372  INPUT J$
374  IF J$ = "N" GOTO 530
400  HGR
410  HCOLOR= 7
420  REM  RANGE VALUES USUALLY LESS THAN 100 CM; DOUBLE VALUE
440  HPLOT 0,80 TO 2 * Q,80                          FOR GRAPHING
450  HCOLOR= 5
460  HPLOT 0,80 TO 2 * XA,80 + 2 * YA
465  HCOLOR= 1
470  HPLOT 0,80 TO 2 * XB,80 + 2 * YB
480  HCOLOR= 6
490  HPLOT 0,80 TO 2 * RX,80 + 2 * RY
500  VTAB (22)
510  PRINT "ORIGINAL MOMENTUM= ";DM;" GRAM-CM"
520  PRINT "RESULTANT MOMENTUM= ";PM;" GRAM-CM"
530  END


END OF LISTING

PROGRAM LENGTH: 63 LINES / 1373 BYTES
```

METRIC CONVERSION

Converting from English units to Metric units is a familiar task for the science student and soon will be one for all people in this country. This program is set up to convert various English units of length, area, mass, and liquid volume to corresponding Metric units.

Data Input

(a) Length - 8 different conversion choices

(b) Area - 8 different conversion choices

(c) Mass - 6 different conversion choices

(d) Liquid Volume - 8 different conversion choices

Results Returned

Conversions of any choices of the English units of length, area, mass and liquid volume into the corresponding Metric values.

```
 10  REM  PAUL SNYDER 9/14/81
 20  REM  METRIC CONVERSION PROGRAM
 30  REM  COMPUTATIONS ARE APPROXIMATE. CONVERSIONS BASED UPON
 40  REM  TABLES PROVIDED IN THE SMALL BUSINESS ADMINISTRATION'S
 50  REM  MANAGMENT AID NO 214 AND NBS PUBLICATION 304A
 60  REM  ********************************************
 70  REM  **********    DATA INITIONALIZATION    ******
 80  LET M = 8
 90  LET M1 = 9
100  LET M2 = 6
110  LET M3 = 8
120  DIM L1$(8),L2$(8),L3(8)
150  DIM A1$(9),A2$(9),A3(9)
180  DIM W1$(6),W2$(6),W3(6)
210  DIM V1$(8),V2$(8),V3(8)
240  FOR I = 1 TO 8
250      READ L1$(I),L2$(I),L3(I)
260  NEXT I
270  FOR I = 1 TO 8
280      READ A1$(I),A2$(I),A3(I)
290  NEXT I
300  FOR I = 1 TO 6
310      READ W1$(I),W2$(I),W3(I)
320  NEXT I
```

```
330  FOR I = 1 TO 8
340      READ V1$(I),V2$(I),V3(I)
350  NEXT I
360  REM  *******************************
370  REM   ****** PROCESSING AREA ******
375  HOME
380  HTAB 9:
     INVERSE :
     PRINT "WHAT DO YOU WISH TO CONVERT"
381  NORMAL
385  VTAB 5
390  PRINT "(L)ENGTH, (A)REA, (M)ASS OR LQ. (V)OLUME"
395  PRINT "(O)UT"
400  INPUT A1$
410  IF A1$ = "O" THEN
         2000
420  HOME :
     HTAB 10:
     PRINT "CONVERSION AVAILABLE"
430  PRINT
440  PRINT  TAB( 05);" # "; TAB( 7);"  FROM"; TAB( 20);" TO"
450  PRINT  TAB( 5);"---"; TAB( 7);"--------"; TAB( 20);"-----------"
460  IF A1$ = "L" THEN
         520
470  IF A1$ = "A" THEN
         650
480  IF A1$ = "M" THEN
         780
490  IF A1$ = "V" THEN
         910
500  PRINT "ENTRY MUST BE L, A, M, OR V."
510  FOR X = 1 TO 2500:
     NEXT :
     GOTO 375
520  REM  ******* PRINT FOR LENGTH *******
530  FOR I = 1 TO M
540      PRINT  TAB( 5);I; TAB( 7);L1$(I); TAB( 20);L2$(I)
550  NEXT I
560  VTAB 14
565  PRINT "
               ":
     VTAB 14
570  INPUT "ENTER THE NUMBER OF THE CONVERSION TO   BE USED (O=END)";N$
571  IF  VAL (N$) <  - 1 OR  VAL (N$) > 8 THEN
         560
575  IF N$ = "" THEN
         560
590  IF  VAL (N$) = 0 THEN
         1040
591  VTAB 18
592  LET N =  VAL (N$)
595  PRINT "                                        "
596  VTAB 18
600  PRINT "ENTER THE NUMBER OF ";L1$(N);
```

```
610  INPUT LO$
611  IF LO$ = "" THEN
         GOTO 591
620  LET L =  VAL (LO$) * L3(N)
625  VTAB 19
627  PRINT "                                                ":
     VTAB 19
630  PRINT LO$;" ";L1$(N);" = ";L;" ";L2$(N)
640  GOTO 560
650  REM  ********** PRINT FOR AREA *************
660  FOR I = 1 TO M
670      PRINT  TAB( 5);I; TAB( 8);A1$(I); TAB( 24);A2$(I)
680  NEXT I
690  VTAB 14
695  PRINT "
      ":
     VTAB 14
700  INPUT "ENTER THE NUMBER OF THE CONVERSION TO   BE USED (O=END)";N$
701  IF  VAL (N$) <  - 1 OR  VAL (N$) > 8 THEN
         560
702  IF N$ = "" THEN
         690
710  LET N =  VAL (N$)
720  IF N = 0 THEN
         1050
725  VTAB 18
730  PRINT "ENTER THE NUMBER OF ";A1$(N);
740  INPUT AO$
745  IF AO$ = "" THEN
         725
750  LET A =  VAL (AO$) * A3(N)
760  PRINT AO$;A1$(N);" = ";A;A2$(N)
770  GOTO 690
780  REM  *************** PRINT OF MASS**********
790  FOR I = 1 TO M2
800      PRINT  TAB( 5);I; TAB( 8);W1$(I); TAB( 20);W2$(I)
801      IF  VAL (N$) <  - 1 OR  VAL (N$) > 8 THEN
             560
810  NEXT I
812  VTAB 14
815  PRINT "
                      ":
     VTAB 14
825  INPUT "ENTER THE NUMBER OF THE CONVERIONS TO   BE USED (O=END)";N$
840  IF N$ = "" THEN
         815
850  IF  VAL (N$) = 0 THEN
         1040
855  LET N =  VAL (N$)
860  PRINT "ENTER THE NUMBER OF ";W1$(N);
870  INPUT WO
880  LET W = WO * W3(N)
890  PRINT WO;W1$(N);"=";W;W2$(N)
```

```
 900  GOTO 815
 910  REM  ********** PRINT OF LIQUID VOLUME ***************
 920  FOR I = 1 TO M3
 930      PRINT  TAB( 5);I; TAB( 8);V1$(I); TAB( 20);V2$(I)
 940  NEXT I
 950  VTAB 14
 955  PRINT "                                                                    ":
      VTAB 14
 960  INPUT "ENTER THE NUMBER OF THE CONVERSION TO BE USED 0=WHEN DONE";N$
 961  IF  VAL (N$) <  - 1 OR  VAL (N$) > 8 THEN
          950
 965  IF  VAL (N$) = 0 THEN
          1040
 966  VTAB 18
 967  LET N =  VAL (N$)
 980  IF N = 0 THEN
          1050
 990  PRINT "ENTER THE NUMBER OF";V1$(N);
1000  INPUT VO
1010  LET V = VO * V3(N)
1020  PRINT VO;V1$(N);"=";V;V2$(N)
1030  GOTO 950
1040  REM ************************************************
1050  REM  ********** PROGRAM TERMINATION POINT *****************
1060  PRINT :
      PRINT
1080  GOTO 375
1090  REM  ***********************************************
1100  REM  ************ DATA FOR INITIONALIZATION ************
1110  REM  ******** LENGHT ********
1120  DATA  "INCHES","MILLIMETERS",25.4,"FEET","METERS",.3048
1130  DATA  "YARDS","METERS",.9144,"MILES","KILOMETERRS",1.6093
1140  DATA "MILLIMETERS","INCHES",.0394,"METERS","FEET",3.2808
1150  DATA  "METERS","YARDS",1.0936,"KILOMETERS","MILES",.6214
1160  REM  *************************AREA
1170  DATA  "SQ INCHES","SQ CENTIMETERS",6.4516,"SQ FEET","SQ METERS",.092
1180  DATA  "SQ YARDS","SQ METERS",.8361,"SQ MILES","SQ KILOMETERS",2.59
1190  DATA   "ACRES","SQ HECTOMETERS",.4047
1200  DATA  "SQ CENTIMETERS","SQ INCHES",.155,"SQ METERS","SQ YARDS",1.196
1210 "SQ KILOMETERS","SQ MILES",.3861
1220  DATA  "SQ HECTOMETERS","ACRES",2.471
1230  REM  ********** MASS
1240  DATA  "OUNCES","GRAMS",28.3495,"POUNDS","KILOGRAM",.4536
1250  DATA "SHORT TONS","MEGAGRAMS",.9,"GRAM","OUNCES",.0353
1260  DATA  "KILOGRAMS","POUNDS",2.2046,"MEGAGRAMS","SHORT TONS",2642
1270  REM  ************ LIQUID VOLUME
1280  DATA  "OUNCES","MILLIMETERS",30,"PINTS","LITERS",.4732
1290  DATA  "QUARTS","LITERS",.9464,"GALLONS","LITERS",3.7856
1300  DATA "MILLILITERS","OUNCES",.03,"LITERS","PINTS",2.1134
1310  DATA  "LITERS","QUARTS",1.0567,"LITERS","GALLONS",.2642
1320  REM  ****************************************
1330  END      END OF LISTING
2000  HOME

           PROGRAM LENGTH: 150 LINES / 4364 BYTES
```

MOLAR RELATIONSHIPS .

This program is one that demands data from the chemistry student. It relates to an experiment where the student place a piece of magnesium in an acidic solution and generates hydrogen gas in order to study molar relationships.

Data Input:
a. mass of 1 meter of magnesium ribbon in grams
b. length of ribbon used in centimeters .
c. volume of hydrogen gas and water vapor collected in milliters
d. temperature at which data was taken in degrees Celcius
e. atmosphereic pressure during experiment in millimeters of mercury

Output:
a. weight of the magnesium piece
b. calculated number of moles of magnesium used
c. the partial pressure of the hydrogen
d. the volume of hydrogen gas at STP
e. calculated volume of gas produced
f. high resolution graphics of the experimental design and layout

```
  1  HOME
  2  LET X = X + 1
  3  HGR
  4  HCOLOR= 3
  5  HPLOT 0,0 TO 279,159
  6  HPLOT 279,0 TO 0,159
  7  HPLOT 139,0 TO 139,159
  8  HPLOT 0,0 TO 279,0
  9  HPLOT 279,0 TO 279,159
 10  HPLOT 279,159 TO 0,159
 11  HPLOT 0,159 TO 0,0
 12  IF X <  > 10 THEN
         1
 13  TEXT
100  HOME
```

```
101  GOSUB 167
102  TEXT :
     HOME :
     CLEAR
103  INPUT "INPUT MASS OF 1 METER OF RIBBON  (GR)   ";WR
104  PRINT
105  INPUT "INPUT LENGTH OF RIBBON USED (CM) ";LR
106  PRINT
107  INPUT "INPUT VOLUME OF H2 AND H2O VAPOR  (ML)  ";D
108  PRINT
109  INPUT "INPUT TEMP. AT WHICH DATA WAS TAKEN (C) TEMP. MUST BE BETWEEN (
     19-30 DEGREES)";TMP
110  LET TMP = TMP + 273
111  PRINT
112  INPUT "INPUT ATMOSPHERIC PRESSURE (MM HG ) ";AMP
113  SPEED= 255
114  READ T:
     READ HP
115  DATA  19,6.5,20,17.5,21,18.7
116  DATA  22,19.8,23,21.1,24,22.4
117  DATA  25,23.8,26,25.2,27,26.7
118  DATA  28,28.3,29,30.0,30,31.8
119  IF T = TMP - 273 THEN
         121
120  GOTO 114
121  LET HP = HP
122  LET T = T
123  REM  HP=VAPOR PRESSURE
124  LET WMG = (LR / 100) * WR
125  LET MOL = WMG / 24.3
126  LET TPR = AMP - HP
127  LET VL2 = (273 * TPR * D) / (760 * TMP)
128  LET VOG = VL2 / MOL
129  LET VOG = VOG / 1000
130  GOSUB 150
131  HOME
132  PRINT "THE WEIGHT OF THE MAGNESIUM PIECE "
133  PRINT WMG;" (GR)"
134  PRINT
135  PRINT "THE CALC. NUMBER OF MOLES IS "
136  PRINT MOL
137  PRINT
138  PRINT "THE PARTIAL PRESSURE OF H2 IS "
139  PRINT TPR;" (MM HG)"
140  PRINT
141  PRINT "THE VOLUME OF HYDROGEN GAS AT (STP)"
142  PRINT VL2;" (ML)"
143  PRINT
144  PRINT "THE CALC. VOL. OF GAS IS "
145  PRINT VOG;" (LITERS PER MOLE)"
```

```
146  PRINT :
     PRINT :
     INPUT "DO YOU WISH TO USE PROGRAM AGAIN (Y/N)  ";V$
147  IF V$ = "Y" THEN
         102
148  IF V$ = "N" THEN
         149
149  END
150  HOME
151  PRINT "MASS OF TOTAL RIBBON ";WR;" (GR)"
152  PRINT
153  PRINT "LENGTH OF RIBBON USED ";LR;" (CM)"
154  PRINT
155  PRINT "INITIAL VOLUME ";D;" (ML)"
156  PRINT
157  PRINT "TEMP. AT WHICH DATA TAKEN ";TMP;" (KELVIN)"
158  PRINT
159  PRINT "ATMOSPHERIC PRESSURE ";AMP;" (MM HG)"
160  PRINT
161  PRINT "VAPOR PRESSURE AT ";T;" (C) IS ";HP;" (MM HG)
162  PRINT :
     PRINT :
     PRINT :
     PRINT "       PRESS ANY KEY TO CONTINUE  "
163  GET Z$
164  IF Z$ <  > "" THEN
         166
165  HOME
166  RETURN
167  FLASH
168  PRINT "MOLAR RELATIONSHIPS"
169  NORMAL
170  VTAB 8:
     HTAB 16
171  PRINT "BY PAUL SNYDER"
172  PRINT :
     PRINT
173  HTAB 17
174  PRINT "AND C.W ILIFF"
175  SPEED= 0
176  PRINT "
177  SPEED= 255
178  HGR
179  HCOLOR= 6
180  HPLOT 141,6 TO 142,6
181  HPLOT 139,7 TO 143,7
182  HPLOT 138,8 TO 144,9
183  HPLOT 137,9 TO 145,9
184  HPLOT 136,10 TO 146,10
185  HPLOT 136,11 TO 146,11
```

```
186  HPLOT 136,12 TO 146,12
187  HPLOT 136,13 TO 146,13
188  HPLOT 138,13 TO 146,13
189  HPLOT 136,13 TO 136,157
190  HPLOT 137,13 TO 137,157
191  HPLOT 138,13 TO 138,157
192  HPLOT 139,13 TO 139,157
193  HPLOT 140,13 TO 140,157
194  HPLOT 142,13 TO 142,157
195  HPLOT 143,13 TO 143,157
196  HPLOT 144,13 TO 144,157
197  HPLOT 145,13 TO 145,157
198  HPLOT 146,13 TO 146,157
199  HPLOT 146,121 TO 146,157
200  HPLOT 147,121 TO 147,157
201  HPLOT 148,121 TO 148,157
202  HPLOT 149,121 TO 149,157
203  HPLOT 150,121 TO 150,157
204  HPLOT 151,121 TO 151,157
205  HPLOT 152,121 TO 152,157
206  HPLOT 153,121 TO 153,157
207  HPLOT 154,121 TO 154,157
208  HPLOT 155,121 TO 155,157
209  HPLOT 156,121 TO 156,156
210  HPLOT 157,121 TO 157,155
211  HPLOT 158,121 TO 158,154
212  HPLOT 159,121 TO 159,153
213  HPLOT 160,121 TO 160,152
214  HPLOT 161,121 TO 161,151
215  HPLOT 121,121 TO 121,151
216  HPLOT 122,121 TO 122,152
217  HPLOT 123,121 TO 123,153
218  HPLOT 124,121 TO 124,154
219  HPLOT 125,121 TO 125,155
220  HPLOT 126,121 TO 126,156
221  HPLOT 127,121 TO 127,157
222  HPLOT 128,121 TO 128,157
223  HPLOT 129,121 TO 129,157
224  HPLOT 130,121 TO 130,157
225  HPLOT 131,121 TO 131,157
226  HPLOT 132,121 TO 132,157
227  HPLOT 134,121 TO 134,157
228  HCOLOR= 1
229  HPLOT 0,159 TO 279,159
230  HCOLOR= 0
231  HPLOT 140,115
232  HPLOT 112,131
233  HPLOT 138,121
234  HPLOT 142,125
235  HPLOT 140,108
236  SPEED= 1:
     PRINT "                    "
```

```
237  HPLOT 137,103
238  SPEED= 1:
     PRINT "                ":
     SPEED= 255
239  HPLOT 144,97:
     SPEED= 1:
     PRINT "                ":
     SPEED= 255
240  HPLOT 135,93:
     SPEED= 1:
     PRINT "                ":
     SPEED= 255
241  HPLOT 141,90:
     SPEED= 1:
     PRINT "               ":
     SPEED= 255
242  HPLOT 144,86:
     SPEED= 1:
     PRINT "                ":
     SPEED= 255
243  HPLOT 137,81:
     SPEED= 1:
     PRINT "                ":
     SPEED= 255
244  HPLOT 140,78:
     SPEED= 1:
     PRINT "                ":
     SPEED= 255
245  HPLOT 139,73:
     SPEED= 1:
     PRINT "           ":
     SPEED= 255
246  HPLOT 141,70:
     SPEED= 1:
     PRINT "           ":
     SPEED= 255
247  HPLOT 137,67:
     SPEED= 1:
     PRINT "           ":
     SPEED= 255
248  HPLOT 141,61:
     SPEED= 1:
     PRINT "           ":
     SPEED= 255
249  HPLOT 140,57:
     SPEED= 1:
     PRINT "           ":
     SPEED= 255
250  SPEED= .25
251  HPLOT 139,51:
     PRINT ""
```

```
252  HPLOT 143,48:
     PRINT ""
253  HPLOT 138,41:
     PRINT ""
254  HPLOT 141,38:
     PRINT ""
255  HPLOT 143,31:
     PRINT ""
256  HPLOT 137,25:
     PRINT ""
257  HPLOT 143,20:
     PRINT ""
258  HPLOT 139,15:
     PRINT ""
259  HPLOT 140,10:
     PRINT ""
260  PRINT "DID YOU SEE THE BUBBLES COLLECT AT THE  TOP OF THE TUBE?"
261  HCOLOR= 3
262  HPLOT 140,6:
     HPLOT 141,6
263  HPLOT 139,7 TO 143,7
264  HPLOT 138,8 TO 144,8
265  HCOLOR= 6
266  HPLOT 121,120 TO 136,120
267  HPLOT 145,120 TO 161,120
268  PRINT "
269  PRINT :
     PRINT
270  PRINT "LOOK FOR THE LIQUID LEVEL TO CHANGE!!!"
271  PRINT "
272  HPLOT 121,119 TO 136,119
273  HPLOT 145,119 TO 161,119
274  HCOLOR= 3
275  PRINT "
276  HPLOT 137,9 TO 145,9
277  HPLOT 137,10 TO 145,10
278  HCOLOR= 6
279  PRINT "
280  HPLOT 121,118 TO 161,118
281  HPLOT 121,117 TO 161,117
282  HCOLOR= 0
283  HPLOT 121,120 TO 125,120
284  PRINT "THE BLACK LINE IS THE PREVIOUS LIQUID   LEVEL
285  HCOLOR= 3
286  HPLOT 137,11 TO 145,11
287  HPLOT 137,12 TO 145,12
288  HCOLOR= 6
289  HPLOT 121,116 TO 161,116
290  HPLOT 121,115 TO 161,115
291  PRINT "
292  HCOLOR= 3
293  HPLOT 137,13 TO 145,13
294  HPLOT 137,14 TO 145,14
295  PRINT "
```

```
296  HCOLOR= 6
297  HPLOT 121,114 TO 161,115
298  HPLOT 121,113 TO 161,113
299  PRINT "
300  HCOLOR= 3
301  HPLOT 137,14 TO 145,14
302  PRINT "                    TIME LAPS
303  SPEED= 255
304  RETURN


     END OF LISTING

     PROGRAM LENGTH: 218 LINES / 4524 BYTES
```

OHM'S LAW

In this program some general information about Ohm's Law is stated at the beginning. The original equation (E=I*R) where the voltage is calculated from the current and the resistance plus the derived equations for finding the current and the resistance are all displayed early in the program. The user can choose which equation he or she wishes to use for the calculations.

Data Input: (a) E -- the voltage in volts

(b) I -- the current in amps

(c) R -- the resistance in ohms

Results Returned

Calculations of E, I or R depending upon the data available.

```
 10  REM  OHM'S LAW FOR DIR CURRENT
 20  REM    **********************
 30  REM   WRITTEN BY TROY OWENS
 40  REM   DATE : 9/11/81
 50  REM   **********************
 60  HOME :
     HTAB 6:
     INVERSE :
     PRINT "OHMS'S LAW FOR DIRECT CURRENT":
     NORMAL
 70  VTAB 4:
     PRINT "ORIGINAL EQUATION :E=I*R"
 80  VTAB 6
 90  PRINT "DERIVED EQUATIONS :  E"
100  PRINT "                    I=-"
110  PRINT "                      R"
120  PRINT
130  PRINT "                      E"
140  PRINT "                    R=-"
150  PRINT "                      I"
160  VTAB 15:
     PRINT "WHERE,"
170  PRINT
```

```
180  PRINT "E = THE VOLTAGE IN VOLTS,"
190  PRINT "I = THE CURRENT IN AMPERES,"
200  PRINT "R = THE RESISTANCE IN OHMS."
210  PRINT ""
220  VTAB 23:
     PRINT "PRESS <RETURN> TO CONTINUE ==>";:
     GET A$
230  HOME
240  VTAB 14
250  INPUT "DO YOU WISH THE COMPUTER TO CALCULATE (Y/N) ?";A$
260  IF A$ = "Y" THEN
          290
270  HOME
280  HOME :
     END
290  HOME
300  INVERSE
305  HTAB 10
310  PRINT "MENU FOR OHM'S LAW"
320  NORMAL
330  PRINT :
     PRINT :
     PRINT
340  PRINT "(1)ORIGINAL EQ = E=I*R"
350  PRINT :
     PRINT
360  PRINT "(2)DERIVED EQ. FOR I"
370  PRINT :
     PRINT
380  PRINT "(3)DERIVED EQ FOR R"
390  PRINT :
     PRINT
392  PRINT "(4)EXIT PROGRAM"
393  PRINT :
     PRINT
394  PRINT "(5)INFORMATION"
395  PRINT :
     PRINT :
     PRINT
400  INPUT " WHICH DO YOU WISH TO USE ?";S
405  IF S > 5 OR S < 1 THEN
          290
410  IF S = 1 THEN
          440
420  IF S = 2 THEN
          590
430  IF S = 3 THEN
          730
```

```
435  IF S = 4 THEN
         280
436  IF S = 5 THEN
         940
440  HOME
450  PRINT "THIS IS THE EQUATION = E=I*R"
460  PRINT :
     PRINT
470  INPUT "ENTER CURRENT IN AMPERES (I)";I
480  PRINT :
     PRINT
490  INPUT "ENTER RESISTNCE IN OHM'S (R)";R
500  PRINT :
     PRINT
510  LET E = I * R
520  PRINT "VOLTAGE = ";E
530  PRINT :
     PRINT
540  VTAB 20
550  INPUT " DO YOU NEED THIS EQ. ANY MORE (Y/N) ?";Y$
560  HOME
570  IF Y$ = "N" THEN
         290
580  IF Y$ = "Y" THEN
         450
590  HOME
600  PRINT "THIS IS THE EQ. I=E/R"
610  PRINT :
     PRINT
620  INPUT "ENTER VOLTAGE (E)";E
630  PRINT :
     PRINT
640  INPUT "ENTER RESISTANCE (R)";R
650  PRINT :
     PRINT
660  LET I = E / R
670  PRINT "CURRENT =";I
680  PRINT :
     PRINT
690  VTAB 20
700  INPUT "DO YOU NEED THIS EQUATION ANY MORE (Y/N) ?";G$
710  IF G$ = "Y" THEN
         590
720  IF G$ = "N" THEN
         290
730  HOME
740  PRINT "THIS IS THE EQUATION -R=E/I"
745  PRINT :
     PRINT
750  INPUT "ENTER VOLTAGE (E)";E
760  PRINT :
     PRINT
765  INPUT "ENTER CURRENT IN AMPERES(I)";I
770  PRINT :
     PRINT
780  LET R = E / I
```

```
 785  PRINT "RESISTANCE =";R
 790  PRINT :
      PRINT
 800  PRINT :
      PRINT
 810  INPUT "DO YOU NEED THIS EQ. ANY MORE (Y/N) ?";F$
 820  IF F$ = "Y" THEN
          730
 830  IF F$ = "N" THEN
          290
 935  INVERSE
 940  HOME
 945  INVERSE
 950  HTAB 14
 955  PRINT "OHM'S LAW"
 960  NORMAL
 965  PRINT :
      PRINT :
      PRINT
 970  PRINT " THE RATIO OF THE POTENTIAL"
 971  PRINT
 975  PRINT "DIFFERENCE BETWEEN THE ENDS"
 976  PRINT
 980  PRINT "OF A WIRE AND THE CURRENT "
 985  PRINT
 990  PRINT "FLOWING THROUGH THE WIRE IS A"
 992  PRINT
 999  PRINT "CONSTANT."
1000  VTAB 20
1001  INPUT "PRESS ANY KEY TO CONTINUE";R$
1003  IF R$ = " " THEN
          1100
1100  HOME
1150  PRINT :
      PRINT :
      PRINT
1200  PRINT "THIS RATIO IS KNOWN AS THE "
1205  PRINT
1250  PRINT "RESISTENCE OF A WIRE."
1255  PRINT
1300  PRINT "IT IS A CONSTANT FOR ANY"
1310  PRINT
1350  PRINT "GIVEN WIRE."
1360  VTAB 20
1400  INPUT "PRESS ANY KEY TO CONTINUE";T$
1405  IF T$ = " " THEN
          1410
1410  HOME
1450  PRINT :
      PRINT :
      PRINT
1455  HTAB 6
1500  PRINT "THIS RELATIONSHIP,KNOWN AS":
      PRINT
```

```
1505  HTAB 6
1550  PRINT "OHM'S LAW, STATES THAT THE":
      PRINT
1556  HTAB 6
1600  PRINT "CURRENT THAT FLOWS THROUGH":
      PRINT
1605  HTAB 6
1650  PRINT "A GIVEN WIRE VARIES DIRECTLY":
      PRINT
1655  HTAB 6
1700  PRINT "WITH THE APPLIED VOLTAGE."
1750  VTAB 20
1800  INPUT "PRESS ANY KEY TO RETURN TO MENU";E$
1850  IF E$ = " " THEN
          290

END OF LISTING

PROGRAM LENGTH: 140 LINES / 2638 BYTES
```

PENDULUMS

This program calculates instantaneous velocity of a pendulum at any length, its period, its period squared ; it graphs the length versus the period and the length versus the period squared; it calculates percent error on students predictions of length for a give period.

Data Input

(a) x and y coordinates of the pendulum location (meters)

(b) lengths of pendulum (meters)

Results Returned

(a) instantaneous velocity (m/sec)

(b) period (sec)

(c) period squared (sec^2)

Limitations

The programs calls for the student to run five experimental trials and to, therefore, input five experimental lengths for the period calculations.

```
100  FOR I = 1 TO 25:
         PRINT :
     NEXT
101  PRINT  TAB( 16)"PENDULUMS"
102  LET X = 138:
     LET Y = 100
103  FOR I = 1 TO 13
104      HGR :
         HCOLOR= 3
```

```
105       HPLOT 138,0 TO X,Y
106       HPLOT X,Y TO X - 25,Y + 25
107       HPLOT X - 25,Y + 25 TO X,Y + 50
108       HPLOT X,Y + 50 TO X + 25,Y + 25
109       HPLOT X + 25,Y + 25 TO X,Y
110       LET X = X - 7
111   NEXT I
112   FOR I = 1 TO 26
113       HGR :
          HCOLOR= 3
114       HPLOT 138,0 TO X,Y
115       HPLOT X,Y TO X - 25,Y + 25
116       HPLOT X - 25,Y + 25 TO X,Y + 50
117       HPLOT X,Y + 50 TO X + 25,Y + 25
118       HPLOT X + 25,Y + 25 TO X,Y
119       LET X = X + 7
120   NEXT
121   FOR I = 1 TO 14
122       HGR :
          HCOLOR= 3
123       HPLOT 138,0 TO X,Y
124       HPLOT X,Y TO X - 25,Y + 25
125       HPLOT X - 25,Y + 25 TO X,Y + 50
126       HPLOT X,Y + 50 TO X + 25,Y + 25
127       HPLOT X + 25,Y + 25 TO X,Y
128       LET X = X - 7
129   NEXT
130   FOR I = 1 TO 1500
131       PRINT ""
132       REM  PENDULUM
133       TEXT :
          HOME
134       HTAB 17:
          PRINT "CATALOG"
136       PRINT :
          PRINT "1. INSTANTANEOUS VELOCITY AT ANY HEIGHT"
137       PRINT :
          PRINT "2. PENDULUM PERIOD CALCULATIONS"
138       PRINT "   (GRAPHING PERIOD VS. LENGTH)"
139       PRINT "   (GRAPHING PERIOD SQUARED VS. LENGTH)"
140       PRINT
141       PRINT "3. EXIT THIS PROGRAM"
142       VTAB 18:
          INPUT "WHICH WOULD YOU LIKE?";A$
143       IF  VAL (A$) = 1 THEN
              168
144       IF  VAL (A$) = 2 THEN
              190
```

```
145       IF  VAL (A$) = 3 THEN
              413
147       GOTO 142
148       HOME
168       HOME
169       REM  INSTANTANEOUS VELOCITY AT ANY HEIGHT
170       INVERSE :
          PRINT "  INSTANTANEOUS VELOCITY AT ANY HEIGHT  ":
          NORMAL
171       ONERR  GOTO 172
172       VTAB 3
173       INPUT "AT WHAT HEIGHT (Y COORDINATE) DID YOU   RELEASE THE PENDULU
          M? (M)";HEIGHT
174       ONERR  GOTO 175
175       VTAB 8
176       INPUT "WHAT IS THE NEW PENDULUM POSITION? (M)";DIS
177       IF DIS > HEIGHT THEN
              179
178       GOTO 180
179       PRINT "IT MUST BE LESS THAN THE FIRST NUMBER!":
          GOTO 174
180       LET G = 9.8
181       LET INSTVEL =  SQR (2 * G * (HEIGHT - DIS))
182       PRINT :
          PRINT :
          PRINT :
          PRINT
183       PRINT "INSTANTANEOUS VELOCITY =   "INSTVEL
184       PRINT :
          PRINT :
          PRINT :
          PRINT
185       VTAB 22
186       INPUT "AGAIN (YES/NO)";B$
187       IF  LEFT$ (B$,1) = "Y" THEN
              168
188       IF  LEFT$ (B$,1) = "N" THEN
              133
189       GOTO 185
190       HOME
191       INVERSE
192       HTAB 6:
          INVERSE :
          PRINT "PENDULUM PERIOD CALCULATIONS"
193       NORMAL
194       PRINT :
          PRINT "'T' = PERIOD   'L' = LENGTH  "
195       FOR I = 1 TO 4:
              PRINT :
          NEXT I
196       PRINT "T=2*3.1416*SQR(L/G)"
```

```
197       PRINT :
          PRINT :
          PRINT :
          PRINT
198       PRINT "G=9.8 M/SEC^2"
199       PRINT :
          PRINT :
          PRINT :
          PRINT
200       LET G = 9.8
201       INPUT "PRESS <RETURN> TO BEGIN.";B$
202       HOME
203       PRINT "WHAT ARE THE LENGTHS OF YOUR PENDULUMS?"
204       PRINT  TAB( 18)"(M)"
205       PRINT
206       INPUT "TRIAL 1 L(1)=";L(1)
207       INPUT "TRIAL 2 L(2)=";L(2)
208       INPUT "TRIAL 3 L(3)=";L(3)
209       INPUT "TRIAL 4 L(4)=";L(4)
210       INPUT "TRIAL 5 L(5)=";L(5)
211       LET T(1) = 2 * 3.14159 *  SQR (L(1) / G)
212       LET T(2) = 2 * 3.14159 *  SQR (L(2) / G)
213       LET T(3) = 2 * 3.14159 *  SQR (L(3) / G)
214       LET T(4) = 2 * 3.14159 *  SQR (L(4) / G)
215       LET T(5) = 2 * 3.14159 *  SQR (L(5) / G)
216       HOME
217       PRINT  TAB( 17)"TRIAL 1"
218       INVERSE
219       PRINT "                                                  ":
          NORMAL
220       PRINT :
          PRINT :
          PRINT
221       PRINT "LENGTH="L(1),"PERIOD="T(1)
222       PRINT :
          PRINT
223       LET TSQ(1) = T(1) ^ 2
224       PRINT "(PERIOD)^2 = "TSQ(1)
225       PRINT :
          PRINT
226       PRINT  TAB( 17)"TRIAL 2"
227       INVERSE :
          PRINT "                                                  ":
          NORMAL
228       PRINT :
          PRINT :
          PRINT
229       PRINT "LENGTH="L(2),"PERIOD="T(2)
230       PRINT :
          PRINT
231       LET TSQ(2) = T(2) ^ 2
232       PRINT "(PERIOD)^2 = "TSQ(2)
```

```
233       PRINT "":
          PRINT
234       PRINT "PRESS A KEY TO CONTINUE.":
          GET B$
235       HOME
236       PRINT  TAB( 17)"TRIAL 3"
237       INVERSE :
          PRINT "                                                    ":
          NORMAL
238       PRINT :
          PRINT :
          PRINT
239       PRINT "LENGTH="L(3),"PERIOD="T(3)
240       LET TSQ(3) = T(3) ^ 2
241       PRINT :
          PRINT
242       PRINT "(PERIOD)^2 = "TSQ(3)
243       PRINT :
          PRINT
244       PRINT  TAB( 17)"TRIAL 4"
245       INVERSE :
          PRINT "                                                    ":
          NORMAL
246       PRINT :
          PRINT :
          PRINT
247       PRINT "LENGTH="L(4),"PERIOD="T(4)
248       PRINT :
          PRINT
249       LET TSQ(4) = T(4) ^ 2
250       PRINT "(PERIOD)^2 = "TSQ(4)
251       PRINT "":
          PRINT
252       PRINT "PRESS A KEY TO CONTINUE":
          GET B$
253       HOME
254       PRINT  TAB( 17)"TRIAL 5"
255       INVERSE :
          PRINT "                                                    ":
          NORMAL
256       PRINT :
          PRINT :
          PRINT
257       PRINT "LENGTH="L(5),"PERIOD="T(5)
258       PRINT :
          PRINT
259       LET TSQ(5) = T(5) ^ 2
260       PRINT "(PERIOD)^2 = "TSQ(5)
261       PRINT "":
          PRINT
262       VTAB 22
263       INPUT "AGAIN (YES/NO)";B$
264       IF  LEFT$ (B$,1) = "Y" THEN
              190
```

```
265       IF  LEFT$ (B$,1) = "N" THEN
              267
266       GOTO 262
267       IF B$ = "Y" THEN
              202
268       HOME
269       PRINT "GRAPHING PERIOD (T) VS. LENGTH (L)"
270       VTAB (24)
271       INPUT "PRESS <RETURN> TO START ===>";B$
272       HOME :
          PRINT "DO YOU WANT TO PLOT THE POINTS":
          PRINT "L(1-5) T(1-5)":
          PRINT "OR DO YOU WANT THE COMPUTER TO PLOT THEM"
273       INPUT "1 OR 2?";S$
274       IF  VAL (S$) = 2 THEN
              337
275       GR
276       COLOR= 4
277       VLIN 0,39 AT 0
278       HLIN 0,39 AT 39
279       GOSUB 281
280       GOTO 322
281       COLOR= 11
282       PLOT 1,37
283       PLOT 2,36.2
284       PLOT 3,35.5
285       PLOT 4,35
286       PLOT 5,34.5
287       PLOT 6,34
288       PLOT 7,33.7
289       PLOT 8,33.2
290       PLOT 9,33
291       PLOT 10,32.7
292       PLOT 11,32.3
293       PLOT 12,32
294       PLOT 13,31.8
295       PLOT 14,31.5
296       PLOT 15,31.2
297       PLOT 16,31
298       PLOT 17,30.7
299       PLOT 18,30.5
300       PLOT 30,28
301       PLOT 24,29
302       PLOT 19,30.3
303       PLOT 31,27
304       PLOT 32,27
305       PLOT 33,27
306       PLOT 34,27
307       PLOT 35,27
308       PLOT 36,26
309       PLOT 37,26
310       PLOT 38,26
311       PLOT 39,26
```

```
312       PLOT 20,30
313       PLOT 21,29
314       PLOT 22,29
315       PLOT 23,29
316       PLOT 25,28
317       PLOT 26,28
318       PLOT 27,28
319       PLOT 28,28
320       PLOT 29,28
321       RETURN
322       FOR I = 1 TO 16:
              PRINT :
          NEXT I
323       INPUT "HOW MANY POINTS DO YOU WISH TO PLOT?";J
324       IF J = 0 THEN
              PRINT "IT MUST BE AT LEAST 1!":
              GOTO 322
325       HOME
326       PRINT "WHAT ARE THE L AND T COORDINATES OF THE POINT YOU WISH TO P
          LOT? (L,T)"
327       FOR I = 1 TO J
328           INPUT "L =";L(Z)
329           IF L(Z) > 39 OR L(Z) < 0 THEN
                  328
330           INPUT "T =";T(Z)
331           IF T(Z) > 39 OR T(Z) < 0 THEN
                  330
332           COLOR= 15
333           LET T(Z) =  ABS (T(Z) - 39)
334           PLOT L(Z),T(Z)
335       NEXT I
336       GOTO 353
337       GR
338       COLOR= 6
339       LET T(1) =  ABS (T(1) - 39)
340       LET T(2) =  ABS (T(2) - 39)
341       LET T(3) =  ABS (T(3) - 39)
342       LET T(4) =  ABS (T(4) - 39)
343       LET T(5) =  ABS (T(5) - 39)
344       HLIN 0,39 AT 39
345       VLIN 0,39 AT 0
346       GOSUB 281
347       COLOR= 15
348       PLOT L(1),T(1)
349       PLOT L(2),T(2)
350       PLOT L(3),T(3)
351       PLOT L(4),T(4)
352       PLOT L(5),T(5)
353       PRINT "PRESS KEY TO CONTINUE":
          GET C$
354       HOME
355       PRINT "PREDICT THE LENGTH (L) OF THE PENDULUM  NEEDED TO PRODUCE
           PERIOD (T) OF 1 SEC."
```

```
356       LET X = 1
357       LET T(X) = 1
358       LET T(X) =  ABS (T(X) - 39)
359       LET PL = 24
360       INPUT "L= ";L(X)
361       COLOR= 15
362       IF L(X) < 0 OR L(X) > 39 THEN
              354
363       PLOT L(X),T(X)
364       PLOT PL,T(X)
365       PRINT "ACTUAL= ";PL,"PREDICTED= ";L(X)
366       LET PER = ((L(X) - PL) / PL) * 145
367       PRINT "PRESS A KEY TO CONTINUE":
          GET B$
368       HOME
369       PRINT "PREDICT THE LENGTH (L) OF THE PENDULUM  NEEDED TO PRODUCE A
           PERIOD (T) OF 2 SEC."
370       LET T(X) = 1
371       LET T(X) =  ABS (T(X) - 39)
372       INPUT "L= ";L(X)
373       COLOR= 9
374       PLOT L(X),T(X)
375       LET PL = 1
376       PLOT PL,T(X)
377       PRINT "ACTUAL= ";PL,"PREDICTED= ";L(X)
378       LET PER = ((L(X) - PL) / PL) * 145
379       PRINT "%ERROR= ";PER
380       PRINT "PRESS A KEY TO CONTINUE":
          GET A$
381       TEXT :
          HOME
382       REM  GRAPHING LENGTH VERSUS PERIOD SQUARED
383       ONERR  GOTO 381
384       PRINT "GRAPHING PERIOD SQUARED VS. LENGTH (L)"
385       VTAB 22
386       PRINT "PRESS KEY TO CONTINUE":
          GET C$
387       GR
388       COLOR= 7
389       VLIN 0,39 AT 0
390       HLIN 0,39 AT 39
391       COLOR= 9
392       PLOT 1,35
393       PLOT 2,31
394       PLOT 3,27
395       PLOT 4,23
396       PLOT 5,19
397       PLOT 6,15
398       PLOT 7,11
399       PLOT 8,7
400       PLOT 9,3
401       FOR I = 1 TO 16:
              PRINT :
          NEXT I
```

```
402       PRINT "WHAT ARE THE L AND TSQ COORDINATES          OF THE POINT YO
          U WISH TO PLOT?"
403       FOR I = 1 TO 5
404           INPUT "L = ?";L(Z)
405           INPUT "T^2 = ?";TSQ(Z)
406           COLOR= 14
407           LET TSQ(Z) =  ABS (TSQ(Z) - 39)
408           PLOT L(Z),TSQ(Z)
409       NEXT I
410       PRINT "PRESS KEY TO CONTINUE":
          GET C$
411       GET C$
412       GOTO 133
413       END


          END OF LISTING

          PROGRAM LENGTH: 293 LINES / 5553 BYTES
```

PERCENT ERROR

This program is designed to take experimental data from the physics and/or chemistry laboratory (or really any science laboratory setting) and to compute the percent error between the experimental answer and the theoretical value. It contains a remedial explanation subprogram for anyone who does not know the theory behind calculating percent error.

Data Input

(a) the number of experimental values to be calculated

(b) the theoretical value

(c) the actual value (or experimental value)

Results Returned

The program will calculate and print out the percent of error for all the experimental values given to the machine from the laboratory data gathering activities.

```
10  HOME
20  PRINT "THIS PROGRAM WILL CALCULATE %          ERROR FOR YOU"
30  PRINT :
    PRINT :
    PRINT :
    PRINT
40  INPUT "DO YOU KNOWN HOW TO DO THIS ON YOUR OWN?(Y/N)";A$
50  IF A$ = "N" GOTO 220
60  HOME
70  INPUT "HOW MANY EXPERIMENTAL VALUES ARE THERE?";N
80  FOR X = 1 TO N
90      PRINT :
        PRINT
100     INPUT "THEORETICAL VALUE=";C
110     PRINT :
        PRINT
120     INPUT "ACTUAL VALUE=";D
130     PRINT :
        PRINT
140     LET E = D - C
150     LET F = E / C
160     LET G = F * 100
170     PRINT "% ERROR=";G
```

```
180  NEXT X
185  PRINT "IF YOU WISH TO EXIT THIS PROGRAM,"
190  PRINT "TYPE IN A (Y)"
192  INPUT X$
195  IF X$ = "Y" GOTO 870
210  GOTO 10
220  HOME
230  PRINT " THIS IS AN EXPLANATION OF THE MECHANICS OF % ERROR."
240  PRINT :
     PRINT
250  PRINT "GET A PIECE OF PAPER."
260  PRINT :
     PRINT
270  INPUT "ARE YOU READY TO CONTINUE?(Y/N)";D$
280  IF D$ = "N" GOTO 230
290  HOME
300  PRINT "PICK AN EXPERIMENTAL VALUE,X"
310  PRINT :
     PRINT
320  INPUT "READY?(Y/N)";E$
330  IF E$ = "N" GOTO 290
340  HOME
350  PRINT "SUBTRACT THE ACTUAL VALUE,Y"
360  PRINT :
     PRINT
370  INPUT "READY?(Y/N)";F$
380  IF F$ = "N" GOTO 290
390  HOME
400  PRINT "AND DIVIDE IT ALL BY THE ACTUAL VALUE,Y"
410  PRINT :
     PRINT
420  PRINT "AND * IT ALL BY 100!"
430  INPUT "READY?(Y/N)";G$
440  IF G$ = "N" GOTO 290
450  HOME
470  PRINT " AND THERE IT IS % ERROR!!!"
480  PRINT :
     PRINT
490  PRINT "DO YOU NEED SOME MORE HELP?"
500  PRINT :
     PRINT
510  PRINT "SEE YOUR TEACHER!!!"
520  PRINT :
     PRINT
530  INPUT "DO YOU UNDERSTAND YET?(Y/N)";H$
540  PRINT :
     PRINT
550  IF H$ = "Y" GOTO 60
560  HOME
570  INPUT "DO YOU WISH TO DO THIS WITH THE COMPUTER?(Y/N)";K$
580  IF  LEFT$ (K$,1) = "N" GOTO 10
590  PRINT :
     PRINT
```

```
600   PRINT " THE VALUES THE COMPUTER HAS CHOSEN ARE:"
605   PRINT "(X=100,Y=10)"
610   PRINT :
      PRINT
620   INPUT "THE FORMULA X-Y/Y*100,READY(Y/N)?";Q$
630   IF Q$ = "N" GOTO 600
640   HOME
650   INPUT "(X-Y)YOU MUST DO THE ARITHMETIC ON YOUR OWN!!!";S$
660   IF S$ = "90" GOTO 700
670   PRINT :
      PRINT
680   PRINT "YOU HAVE MADE A MISTAKE, TRY AGAIN!!!"
690   GOTO 640
700   PRINT "CORRECT, NOW DIVIDE THIS NUMBER"
705   PRINT " BY 'Y'(10)"
710   PRINT :
      PRINT
720   INPUT "VALUE FOR X-Y/Y?";J$
730   IF J$ = "9" THEN
          GOTO 770
740   HOME
750   PRINT "YOU HAVE MADE A MISTAKE, TRY AGAIN!!!"
760   GOTO 720
770   PRINT " CORRECT!!!, NOW MULTIPLY THIS NUMBER"
775   PRINT " BY 100"
780   PRINT :
      PRINT
790   INPUT "YOUR ANSWER PLEASE?";L$
795   HOME
800   IF L$ = "900" THEN
          GOTO 830
810   PRINT "YOU HAVE MADE A MISTAKE,TRY AGAIN"
820   GOTO 790
830   PRINT "CORRECT!!!"
840   PRINT :
      PRINT
850   INPUT "WOULD YOU LIKE TO START OVER?";W$
860   IF W$ = "Y" GOTO 10
870   HOME

880   END


END OF LISTING

PROGRAM LENGTH: 93 LINES / 1913 BYTES
```

PERSFILE

This program deals with creating personnel files. It is a very simple type of program that allows the user to display, creat, delete, edit, list, and print files. It was written before the advent of powerful word processors and is just a beginning in that direction. It creates text files in which to store the data.

```
  1  REM  PERSFILE
  2  REM  6 APRIL 83
  3  REM  D. CALDWELL
  4  TEXT :
     CLEAR
  5  LET D$ =  CHR$ (4)
  6  GOSUB 8000
  7  GOSUB 5000
 10  HOME
 15  IF K > 0 THEN
         PR# 0
 20  HTAB 9:
     PRINT "PERSONNEL DATA FILE"
 30  PRINT :
     PRINT "YOUR CHOICES:"
 40  PRINT :
     PRINT "1) DISPLAY FILE."
 50  PRINT :
     PRINT "2) CREATE FILE.
 60  PRINT :
     PRINT "3) DELETE FILE.
 70  PRINT :
     PRINT "4) EDIT FILE.
 80  PRINT :
     PRINT "5) LIST ALL FILES."
 85  PRINT :
     PRINT "6) PRINTER OPTION."
 86  PRINT :
     PRINT "7) EXIT PROGRAM."
 90  PRINT :
     INPUT "SELECT:";A
100  IF A < 1 OR A > 7 THEN
        90
110  ON A GOTO 200,500,800,1100,1400,1700
120  PRINT D$;"OPEN PERSFILE.DAT"
130  PRINT D$;"WRITE PERSFILE.DAT"
135  FOR B = 1 TO 200
```

```
140       PRINT N$(B):
          PRINT SC$(B):
          PRINT CA$(B):
          PRINT AC$(B):
          PRINT DB$(B):
          PRINT DE$(B):
          PRINT PY$(B)
150   NEXT B
160   PRINT D$;"CLOSE PERSFILE.DAT"
199   END
200   REM  DISPLAY FILE
205   HOME
210   HTAB 14:
      PRINT "DISPLAY FILE"
220   PRINT :
      INPUT " WHAT IS THE FILE NAME?";F$
230   GOSUB 6000
233   IF K > 0 THEN
          VTAB 12:
          PRINT "PRINTING FILE, PLEASE WAIT."

235   IF K > 0 THEN
          GOSUB 9000
240   PRINT :
      PRINT "FILE NUMBER ";B
250   PRINT :
      PRINT N$(B);"     ";"SC: ";SC$(B)
255   PRINT :
      PRINT "CURRENT ASSIGNMENT: ";CA$(B)
260   PRINT :
      PRINT "CERT. AREAS/DATES: ";AC$(B)
265   PRINT :
      PRINT "DATE OF ENTRY: ";DE$(B)
270   PRINT :
      PRINT "PREV. YEARS: ";PY$(B)
275   PRINT :
      PRINT "DATE OF BIRTH: ";DB$(B)
276   PRINT
277   IF K > 0 THEN
          PR# 0:
          PRINT :
          PRINT "DONE."
280   GOSUB 4000
290   GOTO 10
500   REM  ** CREATE FILE
510   HOME
515   HTAB 15:
      PRINT "CREATE FILE"
520   LET F$ = ""
530   GOSUB 6000
540   PRINT :
      INPUT "WHAT IS THE PERSON'S NAME?";N$(B)
550   PRINT :
      INPUT "ASSIGNED TO WHICH SCHOOL?";SC$(B)
```

```
555  PRINT :
     INPUT "WHAT IS HIS CURRENT ASSIGNMENT?";CA$(B)
560  PRINT :
     PRINT "WHAT ARE HIS CERTIFICATION AREAS AND ":
     INPUT "DATES?";AC$(B)
580  PRINT :
     INPUT "DATE OF ENTRY INTO SCHOOL SYSTEM?";DE$(B)
584  PRINT :
     INPUT "WHAT IS THE DATE OF BIRTH?";DB$(B)
586  PRINT :
     INPUT "PREVIOUS YEARS OF EXPERIENCE?";PY$(B)
590  PRINT :
     PRINT "VERIFICATION:"
600  FOR S = 1 TO 1000:
     NEXT S
610  PRINT :
     PRINT N$(B);"     ";"SC: ";SC$(B)
620  PRINT :
     PRINT "CURRENT ASIGNMENT: ";CA$(B)
624  PRINT :
     PRINT "CERT. AREAS: ";AC$(B)
626  PRINT :
     PRINT "PREV. EXP.: ";PY$(B);"     ";"DATE OF ENTRY";DE$(B)
630  PRINT :
     PRINT "DATE OF BIRTH: ";DB$(B)
640  PRINT :
     HTAB 10:
     PRINT "PRESS 'V' TO VERIFY"
650  PRINT :
     HTAB 5:
     PRINT "PRESS ANY OTHER KEY TO EDIT"
655  GET A$
660  IF A$ = "V" THEN
         10
670  IF C = 214 THEN
         10
680  HOME
690  GOSUB 7000
700  GOSUB 4000
710  GOTO 10
800  REM  ** DELETE FILE
810  HOME
820  INVERSE :
     PRINT :
     HTAB 14:
     PRINT "DELETE FILE":
     NORMAL
830  PRINT :
     INPUT "WHAT IS THE FILE NAME?";F$
840  GOSUB 6000
850  LET D = 200 - B
855  IF D = 0 THEN
         950
```

```
860  FOR E = B TO D
870       LET N$(E) = N$(E + 1):
          LET SC$(E) = SC$(E + 1):
          LET CA$(E) = CA$(E + 1):
          LET AC$(E) = AC$(E + 1):
          LET DB$(E) = DB$(E + 1):
          LET PY$(E) = PY$(E + 1)
875       LET DE$(E) = DE$(E + 1)
890       LET N$(E + 1) = "":
          LET SC$(E + 1) = "                ":
          LET CA$(E + 1) = "":
          LET AC$(E + 1) = "":
          LET DB$(E + 1) = "":
          LET PY$(E + 1) = ""
895  NEXT E
900  PRINT "FILE ";F$;" HAS BEEN DELETED"
910  FOR S = 1 TO 1400:
     NEXT S:
     GOTO 10
1100 REM  ** EDIT FILES
1105 HOME
1110 HTAB 14:
     PRINT "EDIT FILES"
1120 PRINT :
     PRINT "WHAT IS THE NAME OF THE FILE THAT YOU "
1130 INPUT "WANT TO EDIT?";F$
1140 GOSUB 6000:
     REM  SEARCH
1150 GOSUB 7000:
     REM  EDIT
1160 GOTO 10
1400 REM  **LIST FILES
1405 HOME
1406 IF K > 0 THEN
         VTAB 12:
         PRINT "NOW PRINTING FILES, PLEASE WAIT."
1410 FOR LL = 1 TO 200
1411      IF K > 0 THEN
              GOSUB 9000
1415      IF N$(LL) = "" THEN
              10
1416      PRINT
1420      PRINT "FILE NUMBER ";LL
1430      PRINT :
          PRINT "NAME: ";N$(LL)
1440      PRINT :
          PRINT "SCHOOL: ";SC$(LL)
1445      PRINT :
          PRINT "CURRENT ASSIGNMENT: ";CA$(LL)
1450      PRINT :
          PRINT "CERT. AREAS: ";AC$(LL)
1460      PRINT :
          PRINT "BIRTH DATE: ";DB$(LL)
```

```
1470      PRINT :
          PRINT "DATE OF ENTRY: ";DE$(LL)
1480      PRINT :
          PRINT "PREVIOUS YEARS OF EXPERIENCE: ";PY$(LL)
1485      IF K > 0 THEN
              PR# 0:
              GOTO 1500
1490      GOSUB 4000
1500  NEXT LL
1505  PRINT :
      PRINT "DONE.":
      FOR S = 1 TO 1000:
      NEXT S
1510  GOTO 10
1700  REM  ** PRINTER ON **
1710  HOME :
      HTAB 10:
      PRINT "PRINTER STATUS"
1715  IF PT > 0 THEN
          1770
1720  PRINT :
      PRINT "ARE YOU USING:"
1730  PRINT :
      PRINT "A.  A DECWRITER?":
      PRINT :
      PRINT "B.  AN EPSON OR APPLE PRINTER?":
      PRINT :
      INPUT "CHOICE:";AN$
1740  IF AN$ < "A" OR AN$ > "B" THEN
          1720
1750  IF AN$ = "A" THEN
          LET PT = 1
1760  IF AN$ = "B" THEN
          LET PT = 2
1770  PRINT :

      PRINT "THE PRINTER IS NOW ";
1780  IF K < 1 THEN
          PRINT "OFF."
1790  IF K >  = 1 THEN
          PRINT "ON."
1800  PRINT :
      INPUT "DO YOU WANT TO CHANGE THIS?";AN$
1810  IF AN$ = "N" OR AN$ = "NO" THEN
          1860
1820  IF K > 0 THEN
          LET K = 0
1830  IF K < 1 THEN
          LET K = PT
1840  PRINT :
      PRINT "DONE."
```

```
1860  FOR S = 1 TO 1000:
      NEXT S:
      GOTO 10
4000  REM  SPACEBAR SUBRTN
4010  VTAB 24:
      HTAB 10:
      PRINT "PRESS 'ESC' TO CONTINUE."
4020  LET Q =  PEEK ( - 16384)
4030  IF Q ) 127 THEN
          4050
4040  GOTO 4020
4050  POKE  - 16368,0
4060  HOME :
      RETURN
5000  REM  ** GET FILES **
5005  DIM N$(200),SC$(200),CA$(200),AC$(200),DB$(200),DE$(200),PY$(200)
5010  PRINT D$;"OPEN PERSFILE.DAT"
5020  PRINT D$;"READ PERSFILE.DAT"
5030  FOR B = 1 TO 200
5040      INPUT N$(B):
          INPUT SC$(B):
          INPUT CA$(B):
          INPUT AC$(B):
          INPUT DB$(B):
          INPUT DE$(B):
          INPUT PY$(B)
5050  NEXT B
5060  PRINT D$;"CLOSE PERSFILE.DAT"
5070  RETURN
6000  REM  ** SEARCH FILES **
6010  FOR B = 1 TO 200
6020      IF F$ = N$(B) THEN
              RETURN
6030      IF N$(B) = "" THEN
              LET B = 200
6040  NEXT B
6050  PRINT :
      PRINT "** NO SUCH FILE EXISTS."
6060  FOR S = 1 TO 700:
      NEXT S:
      GOTO 10
7000  REM  ** EDIT FILE **
7010  HOME
 7020  PRINT "FILE NUMBER ";B
 7030  PRINT :
       PRINT "1) NM: ";N$(B):
       PRINT :
       PRINT "2) SC: ";SC$(B):
       PRINT :
       PRINT "3) CA: ";CA$(B):
       PRINT :
       PRINT "4) AC: ";AC$(B):
       PRINT :
       PRINT "5) DOB: ";DB$(B):
```

```
      PRINT :
      PRINT "6) DOE: ";DE$(B):
      PRINT :
      PRINT "7) PY: ";PY$(B)
7040  PRINT :
      INPUT "WHAT LINE NUMBER DO YOU WANT TO EDIT?";LN
7050  IF LN < 1 OR LN > 7 THEN
          GOTO 7040
7060  IF LN = 1 THEN
          INPUT "NEW NAME: ";N$(B)
7070  IF LN = 2 THEN
          INPUT "NEW SCHOOL: ";SC$(B)
7080  IF LN = 3 THEN
          INPUT "NEW ASSIGNMENT(S): ";CA$(B)
7090  IF LN = 4 THEN
          INPUT "CHANGE CERT. AREAS/DATES: ";AC$(B)
7100  IF LN = 5 THEN
          INPUT "CORRECT DATE OF BIRTH: ";DB$(B)
7110  IF LN = 6 THEN
          INPUT "CORRECT DATE OF ENTRY: ";DE$(B)
7120  IF LN = 7 THEN
          INPUT "CHANGE YEARS OF EXPERIENCE: ";PY$(B)
7130  FOR S = 1 TO 1000:
      NEXT S
7140  RETURN
8000  REM  ** TITLE PAGE **
8010  HOME
8020  VTAB 10:
      HTAB 10:
      PRINT "PERSONNEL DATA MANAGER"
8030  PRINT :
      HTAB 15:
      PRINT "VERSION 2.2"
8040  PRINT :
      PRINT :
      HTAB 19:
      PRINT "BY"
8050  PRINT :
      HTAB 13:
      PRINT "DENNIS CALDWELL"
8060  FOR S = 1 TO 1200:
      NEXT S
8070  RETURN
9000  REM   OUTPUT TO PRINTER
9005  IF PT > 1 THEN
          9020
9010  PR# 1:
```

```
      PRINT  CHR$ (9);"80N"; CHR$ (13):
      PRINT  CHR$ (9);"3P"; CHR$ (13):
      PRINT  CHR$ (9);"1D"; CHR$ (13)
9020  IF PT > 1 THEN
          PR# 1
9030  RETURN


END OF LISTING

PROGRAM LENGTH: 184 LINES / 4608 BYTES
```

PLOT-1

Plot-1 produces numbers in high resolution graphics (numbers "0" through "9") in Apple Soft Language. It does not produce shape tables.

```
 10  REM  ***********************
 20  REM
 30  REM    HGR NUMBER PLOTTER
 40  REM
 50  REM       WRITTEN BY
 60  REM  TROY OWENS
 70  REM  DATE: 7/22/81
 80  REM
 90  REM  ***********************
100  HGR
110  FOR I = 1 TO 24
120      PRINT
130  NEXT I
140  PRINT "WHAT NUMBER (0-9)"
150  INPUT A
160  IF A < 0 OR A > 9 THEN
         140
170  PRINT "WHAT X CORDINATE (5-270)"
180  INPUT X
190  IF X < 5 OR X > 270 THEN
         170
200  PRINT "WHAT Y CORDINATE (5-153)"
210  INPUT Y
220  IF Y < 5 OR Y > 153 THEN
         200
230  HCOLOR= 3
240  IF A = 0 THEN
         GOSUB 390
250  IF A = 1 THEN
         GOSUB 810
260  IF A = 2 THEN
         GOSUB 1030
270  IF A = 3 THEN
         GOSUB 1340
280  IF A = 4 THEN
         GOSUB 1640
290  IF A = 5 THEN
         GOSUB 1850
300  IF A = 6 THEN
         GOSUB 2170
310  IF A = 7 THEN
         GOSUB 2560
320  IF A = 8 THEN
         GOSUB 2790
330  IF A = 9 THEN
         GOSUB 3170
340  PRINT "ANOTHER NUMBER?"
350  INPUT A$
```

```
360  IF A$ = "NO" THEN
         TEXT :
         HOME :
         END
370  IF A$ = "N" THEN
         TEXT :
         HOME :
         END
380  GOTO 110
390  LET X = X + 1
400  LET Y = Y - 1
410  HPLOT X,Y
420  LET X = X - 1
430  HPLOT X,Y
440  LET X = X + 2
450  HPLOT X,Y
460  LET Y = Y + 1
470  LET X = X - 3
480  HPLOT X,Y
490  LET X = X + 4
500  HPLOT X,Y
510  LET Y = Y + 1
520  HPLOT X,Y
530  LET X = X - 1
540  HPLOT X,Y
550  LET X = X - 3
560  HPLOT X,Y
570  LET Y = Y + 1
580  HPLOT X,Y
590  LET X = X + 2
600  HPLOT X,Y
610  LET X = X + 2
620  HPLOT X,Y
630  LET Y = Y + 1
640  HPLOT X,Y
650  LET X = X - 3
660  HPLOT X,Y
670  LET X = X - 1
680  HPLOT X,Y
690  LET Y = Y + 1
700  HPLOT X,Y
710  LET X = X + 4
720  HPLOT X,Y
730  LET Y = Y + 1
740  LET X = X - 1
750  HPLOT X,Y
760  LET X = X - 1
770  HPLOT X,Y
780  LET X = X - 1
790  HPLOT X,Y
800  RETURN
810  LET X = X + 1
820  HPLOT X,Y
830  LET X = X - 2
```

```
 840  LET Y = Y - 1
 850  HPLOT X,Y
 860  LET X = X + 1
 870  HPLOT X,Y
 880  LET X = X + 1
 890  HPLOT X,Y
 900  FOR I = 1 TO 6
 910      LET Y = Y + 1
 920      HPLOT X,Y
 930  NEXT I
 940  LET X = X - 2
 950  HPLOT X,Y
 960  LET X = X + 1
 970  HPLOT X,Y
 980  LET X = X + 2
 990  HPLOT X,Y
1000  LET X = X + 1
1010  HPLOT X,Y
1020  RETURN
1030  LET Y = Y - 1
1040  HPLOT X,Y
1050  LET X = X + 1
1060  HPLOT X,Y
1070  LET X = X + 1
1080  HPLOT X,Y
1090  LET X = X - 3
1100  LET Y = Y + 1
1110  HPLOT X,Y
1120  LET X = X + 4
1130  HPLOT X,Y
1140  LET Y = Y + 1
1150  HPLOT X,Y
1160  LET X = X - 1
1170  LET Y = Y + 1
1180  HPLOT X,Y
1190  LET X = X - 1
1200  HPLOT X,Y
1210  LET X = X - 1
1220  LET Y = Y + 1
1230  HPLOT X,Y
1240  LET X = X - 1
1250  LET Y = Y + 1
1260  HPLOT X,Y
1270  LET Y = Y + 1
1280  HPLOT X,Y
1290  FOR I = 1 TO 4
1300      LET X = X + 1
1310      HPLOT X,Y
1320  NEXT I
1330  RETURN
1340  LET Y = Y - 1
1350  HPLOT X,Y
```

```
1360  FOR I = 1 TO 5
1370      LET X = X + 1
1380      HPLOT X,Y
1390  NEXT I
1400  LET Y = Y + 1
1410  HPLOT X,Y
1420  LET X = X - 1
1430  LET Y = Y + 1
1440  HPLOT X,Y
1450  LET X = X - 1
1460  LET Y = Y + 1
1470  HPLOT X,Y
1480  LET X = X + 1
1490  HPLOT X,Y
1500  LET X = X + 1
1510  LET Y = Y + 1
1520  HPLOT X,Y
1530  LET Y = Y + 1
1540  HPLOT X,Y
1550  LET Y = Y + 1
1560  FOR I = 1 TO 4
1570      LET X = X - 1
1580      HPLOT X,Y
1590  NEXT I
1600  LET X = X - 1
1610  LET Y = Y - 1
1620  HPLOT X,Y
1630  RETURN
1640  LET Y = Y - 1
1650  LET X = X + 5
1660  HPLOT X,Y
1670  FOR I = 1 TO 4
1680      LET X = X - 1
1690      LET Y = Y + 1
1700      HPLOT X,Y
1710  NEXT I
1720  LET X = X + 4
1730  LET Y = Y - 4
1740  FOR I = 1 TO 6
1750      LET Y = Y + 1
1760      HPLOT X,Y
1770  NEXT I
1780  LET X = X - 4
1790  LET Y = Y - 2
1800  FOR I = 1 TO 5
1810      LET X = X + 1
1820      HPLOT X,Y
1830  NEXT I
1840  RETURN
1850  LET Y = Y - 1
1860  LET X = X + 8
1870  FOR I = 1 TO 6
```

```
1880        LET X = X - 1
1890        HPLOT X,Y
1900    NEXT I
1910    LET Y = Y + 1
1920    HPLOT X,Y
1930    LET Y = Y + 1
1940    HPLOT X,Y
1950    FOR I = 1 TO 4
1960        LET X = X + 1
1970        HPLOT X,Y
1980    NEXT I
1990    LET X = X + 1
2000    LET Y = Y + 1
2010    HPLOT X,Y
2020    LET Y = Y + 1
2030    HPLOT X,Y
2040    LET Y = Y + 1
2050    HPLOT X,Y
2060    LET X = X - 1
2070    LET Y = Y + 1
2080    HPLOT X,Y
2090    FOR I = 1 TO 3
2100        LET X = X - 1
2110        HPLOT X,Y
2120    NEXT I
2130    LET X = X - 1
2140    LET Y = Y - 1
2150    HPLOT X,Y
2160    RETURN
2170    LET X = X + 7
2180    LET Y = Y - 1
2190    HPLOT X,Y
2200    FOR I = 1 TO 2
2210        LET X = X - 1
2220        HPLOT X,Y
2230    NEXT I
2240    FOR I = 1 TO 2
2250        LET X = X - 1
2260        LET Y = Y + 1
2270        HPLOT X,Y
2280    NEXT I
2290    LET X = X - 1
2300    LET Y = Y + 1
2310    HPLOT X,Y
2320    FOR I = 1 TO 4
2330        LET X = X + 1
2340        HPLOT X,Y
2350    NEXT I
2360    LET X = X + 1
2370    LET Y = Y + 1
2380    HPLOT X,Y
2390    LET Y = Y + 1
2400    HPLOT X,Y
```

```
2410  LET X = X - 1
2420  LET Y = Y + 1
2430  HPLOT X,Y
2440  FOR I = 1 TO 3
2450      LET X = X - 1
2460      HPLOT X,Y
2470  NEXT I
2480  LET Y = Y - 1
2490  LET X = X - 1
2500  HPLOT X,Y
2510  LET Y = Y - 1
2520  HPLOT X,Y
2530  LET Y = Y - 1
2540  HPLOT X,Y
2550  RETURN
2560  LET Y = Y - 1
2570  LET X = X + 2
2580  HPLOT X,Y
2590  FOR I = 1 TO 5
2600      LET X = X + 1
2610      HPLOT X,Y
2620  NEXT I
2630  LET Y = Y + 1
2640  HPLOT X,Y
2650  LET X = X - 1
2660  LET Y = Y + 1
2670  HPLOT X,Y
2680  LET X = X - 1
2690  LET Y = Y + 1
2700  HPLOT X,Y
2710  LET X = X - 1
2720  LET Y = Y + 1
2730  HPLOT X,Y
2740  LET Y = Y + 1
2750  HPLOT X,Y
2760  LET Y = Y + 1
2770  HPLOT X,Y
2780  RETURN
2790  LET Y = Y - 1
2800  LET X = X + 3
2810  HPLOT X,Y
2820  FOR I = 1 TO 2
2830      LET X = X + 1
2840      HPLOT X,Y
2850  NEXT I
2860  LET X = X + 1
2870  LET Y = Y + 1
2880  HPLOT X,Y
2890  LET Y = Y + 1
2900  HPLOT X,Y
2910  LET X = X - 4
2920  LET Y = Y - 1
2930  HPLOT X,Y
```

```
2940  LET Y = Y + 1
2950  HPLOT X,Y
2960  LET Y = Y + 1
2970  FOR I = 1 TO 3
2980      LET X = X + 1
2990      HPLOT X,Y
3000  NEXT I
3010  LET X = X + 1
3020  LET Y = Y + 1
3030  HPLOT X,Y
3040  LET Y = Y + 1
3050  HPLOT X,Y
3060  LET Y = Y + 1
3070  FOR I = 1 TO 3
3080      LET X = X - 1
3090      HPLOT X,Y
3100  NEXT I
3110  LET X = X - 1
3120  LET Y = Y - 1
3130  HPLOT X,Y
3140  LET Y = Y - 1
3150  HPLOT X,Y
3160  RETURN
3170  LET Y = Y - 1
3180  LET X = X + 4
3190  HPLOT X,Y
3200  FOR I = 1 TO 2
3210      LET X = X - 1
3220      HPLOT X,Y
3230  NEXT I
3240  LET X = X - 1
3250  LET Y = Y + 1
3260  HPLOT X,Y
3270  LET Y = Y + 1
3280  HPLOT X,Y
3290  LET X = X + 1
3300  LET Y = Y + 1
3310  HPLOT X,Y
3320  LET X = X + 1
3330  HPLOT X,Y
3340  LET X = X + 1
3350  HPLOT X,Y
3360  LET X = X + 1
3370  LET Y = Y - 2
3380  HPLOT X,Y
3390  LET Y = Y + 1
3400  HPLOT X,Y
3410  LET Y = Y + 1
3420  HPLOT X,Y
3430  LET Y = Y + 1
3440  HPLOT X,Y
3450  LET X = X - 1
```

```
3460  LET Y = Y + 1
3470  HPLOT X,Y
3480  LET Y = Y + 1
3490  FOR I = 1 TO 3
3500      LET X = X - 1
3510      HPLOT X,Y
3520  NEXT I
3530  RETURN


END OF LISTING

PROGRAM LENGTH: 353 LINES / 3551 BYTES
```

PROJECTILE MOTION

This program computes, from a given velocity and angle of projection, the range, height of trajectory and time of flight. It will graphically demonstrate the trajectory and compare it to the maximum range trajectory at 45 degrees and the trajectory of the complement of the given angle.

Data Input

(a) velocity (in n m/sec or ft/sec)

(b) units (metric or english)

(c) angle of projection (degrees from horizontal)

Results Returned

(a) range, height, time of flight

(b) range and time of flight for 45 degrees

(c) trajectories for given angle, 45 degrees, complement of given angle.

```
 10  TEXT :
     HOME
 30  HTAB 4:
     INVERSE :
     PRINT "PROJECTILE ==============> MOTION":
     NORMAL
 80  DIM T(280),R(280),H(280)
 90  VTAB 7
100  PRINT "ENTER VELOCITY IN (M/SEC) OR (FT/SEC)";
110  INPUT V
120  PRINT "IF M/SEC, ENTER 1 : IF FT/SEC ENTER 2";
130  INPUT U
140  IF U = 2 THEN
         170
150  LET G = 9.8
160  GOTO 180
170  LET G = 32
180  PRINT :
     PRINT "ENTER ANGLE IN DEGREES ";
190  INPUT B
200  LET ANG = B
210  LET ANG = ANG / 57.3
220  LET A = ANG * 2
230  LET R = V ^ 2 *  SIN (A) / G
240  LET R = R * 100:
     LET R =  INT (R):
     LET R = R / 100
250  LET T = R / (V *  COS (ANG))
```

```
260  LET T = T * 100:
     LET T =  INT (T):
     LET T = T / 100
270  LET TF = T / 2
280  LET H = (G * TF ^ 2) / 2
290  LET H = H * 100:
     LET H =  INT (H):
     LET H = H / 100
300  HOME :
     VTAB 3
305  PRINT "VELOCITY = ";V;"  ANGLE = ";B
306  VTAB 5
310  INVERSE
320  PRINT "EXPERIMENTAL VALUES"
330  NORMAL
340  PRINT "RANGE= ";R
350  PRINT "TIME OF FLIGHT=  ";T
360  PRINT "HEIGHT OF TRAJECTORY= ";H
370  LET RM = V ^ 2 / G
380  LET RM = RM * 100:
     LET RM =  INT (RM):
     LET RM = RM / 100
390  LET TM = V / (G * .707)
400  LET TM = TM * 100:
     LET TM =  INT (TM):
     LET TM = TM / 100
410  PRINT
420  INVERSE
430  PRINT "MAXIMUM VALUES AT 45 DEGREES"
440  NORMAL
450  PRINT "RANGE (45) =  ";RM
460  PRINT "TIME OF FLIGHT (45) =  ";TM
470  PRINT
480  PRINT "DO YOU WISH TO SEE THE TRAJECTORY ";
490  INPUT Y$
500  IF  LEFT$ (Y$,1) = "N" THEN
         1000
505  PRINT
510  PRINT "DO YOU WISH TO COMPARE YOUR TRAJECTORY  WITH THE MAXIMUM TRAJEC
     TORY";
520  INPUT M$
525  PRINT
530  PRINT "DO YOU WISH TO SEE THE COMPLEMENTARY    ANGLE OF THE ORIGINAL A
     NGLE ";
540  INPUT C$
600  HOME
610  HGR
620  HCOLOR= 3
630  HPLOT 0,148 TO 275,148
640  HCOLOR= 1
650  LET K = 1
660  GOTO 690
```

```
670  IF  LEFT$ (M$,1) = "Y" THEN
         700
680  IF  LEFT$ (M$,1) = "Y" THEN
         750
690  GOTO 810
700  HCOLOR= 6
710  LET N = 275
720  LET ANG = 45 / 57.3
730  LET TT = TM
740  GOTO 840
750  LET ANG = (90 - B) / 57.3
760  LET R = V ^ 2 *  SIN (ANG * 2) / G
770  LET TT = R / (V *  COS (ANG))
780  HCOLOR= 2
785  LET P = RS * R
790  LET N =  INT (P)
800  GOTO 840
810  LET RS = 275 / RM
815  LET P = RS * R
820  LET N =  INT (P)
830  LET TT = T
836  VTAB 22:
     PRINT "                                                    ":
     VTAB 22
837  HTAB 8:
     INVERSE :
     PRINT "PLEASE WAIT! CALCULATING":
     NORMAL
840  FOR J = 1 TO N
850      LET T(J) = TT / N * J
860      LET R(J) = V *  COS (ANG) * T(J) * RS
870      LET H(J) = V *  SIN (ANG) * T(J) - .5 * G * T(J) ^ 2
880      LET H(J) = H(J) * RS
890      LET H(J) = 148 - H(J)
910  NEXT J
915  FOR J = 1 TO N
916      HPLOT R(J),H(J)
917  NEXT
918  FOR J = 1 TO N:
         LET R(J) = 0:
         LET H(J) = 0:
     NEXT
920  LET K = K + 1
930  IF K = 2 THEN
         670
940  IF K = 3 THEN
         680
950  VTAB (22)
960  LET R = R * 100:
     LET R =  INT (R):
     LET R = R / 100
970  PRINT "   RANGE=  ";R;"   HEIGHT=  ";H
1000 END

END OF LISTING

PROGRAM LENGTH: 99 LINES / 1818 BYTES
```

PROLOGUE.SYS.

This program is the title page of the disc; it boots up the disc by providing initialization. This program contains all of the integer basic files needed in order for the machine to run properly.

```
 10  HOME
 20  VTAB 6
 30  HTAB 14
 40  PRINT "1981 - 1982"
 50  PRINT :
     PRINT
 60  HTAB 16
 70  PRINT "PROGRAMS"
 80  PRINT
 90  HTAB 19:
     PRINT "BY"
100  PRINT :
     PRINT
110  HTAB 8
120  PRINT "DR. MARCELLINE A. BARRON"
130  PRINT
140  HTAB 11
150  PRINT " DR. ROGER BURGESS"
160  PRINT
170  HTAB 14
180  PRINT "TROY S. OWENS"
190  VTAB 22
200  REM  --POKE LANGUAGE CARD FINDER
210  POKE 768,0:
     POKE 769,173:
     POKE 770,0:
     POKE 771,224:
     POKE 772,72:
     POKE 773,173:
     POKE 774,129:
     POKE 775,192:
     POKE 776,104:

220  POKE 777,72:
     POKE 778,205:
     POKE 779,0:
     POKE 780,224:
     POKE 781,208:
     POKE 782,35:
     POKE 783,173:
     POKE 784,131:
     POKE 785,192:
```

```
230  POKE 786,173:
     POKE 787,131:
     POKE 788,192:
     POKE 789,169:
     POKE 790,165:
     POKE 791,141:
     POKE 792,0:
     POKE 793,208:
     POKE 794,205:

240  POKE 795,0:
     POKE 796,208:
     POKE 797,208:
     POKE 798,19:
     POKE 799,74:
     POKE 800,141:
     POKE 801,0:
     POKE 802,208:
     POKE 803,205:

250  POKE 804,0:
     POKE 805,208:
     POKE 806,208:
     POKE 807,10:
     POKE 808,173:
     POKE 809,129:
     POKE 810,192:
     POKE 811,173:
     POKE 812,129:

260  POKE 813,192:
     POKE 814,169:
     POKE 815,1:
     POKE 816,208:
     POKE 817,2:
     POKE 818,169:
     POKE 819,0:
     POKE 820,141:
     POKE 821,0:

270  POKE 822,3:
     POKE 823,104:
     POKE 824,205:
     POKE 825,0:
     POKE 826,224:
     POKE 827,240:
     POKE 828,3:
     POKE 829,173:
     POKE 830,128:

280  POKE 831,192:
     POKE 832,96:
```

```
290  CALL 769
300  IF  PEEK (768) <  > 1 THEN
         400
310  REM
320  REM --IF THERE, LOAD INTG AND PA#1
330  REM
340  PRINT " (LOADING INTEGER INTO LANGUAGE CARD)"
350  PRINT "BLOAD INTBASIC,A$D000"
360  REM  --WRITE PROTECT THE CARD
370  LET A =  PEEK ( - 16254):
     REM   $C082
380  NEW
390  END
400  REM
410  REM --NO CARD OR CAN'T RELOAD
420  REM
430  IF  PEEK (768) = 0 THEN
         END
440  PRINT :

     PRINT "...LANGUAGE CARD CANNOT BE RELOADED":
     PRINT "   UNTIL THE SYSTEM IS REBOOTED..."
450  END
```

END OF LISTING

PROGRAM LENGTH: 45 LINES / 1216 BYTES

REFRACTION

This program presents graphically the refraction of a ray at the interface of two media of different optical densities.

Data Input:

(a) angle of incidence

(b) angle of refraction

Results Returned

(a) index of refraction of second medium

(b) graphical display of ray undergoing refraction

```
 10  TEXT :
     HOME :
     SPEED= 255:
     NORMAL :
     LET ZM = 24
 20  HOME :
     HGR
 30  HCOLOR= 3:
     HPLOT 160,79 TO 70,79 TO 115,140 TO 160,79
 40  HPLOT 1,1 TO 100,79 TO 145,100
 50  DATA  5,1,6,2
 60  FOR K = 1 TO 4:
         READ CO:
         HCOLOR= CO
 70      FOR Y = 100 + (K - 1) * 5 TO 100 + K * 5:
             HPLOT 145,100 TO 279,Y:
         NEXT :
     NEXT
 80  FOR KL = 1 TO 4000:
     NEXT KL
 90  TEXT :
     TEXT
100  HOME
110  PRINT "PROGRAM REFRATION"
210  PRINT "WHAT IS YOUR ANGLE OF INCIDENCE?"
310  PRINT "(MINIMUM-MAXIMUM: 25 TO 75)"
410  INPUT X
510  IF X < 25 OR X > 70 THEN
         710
610  GOTO 910
710  PRINT "TRY AGIAN AND WATCH YOUR LIMITS"
810  GOTO 210
910  PRINT "WHAT IS YOUR ANGLE OF REFRACTION?"
1010 PRINT "(MINIMUM-MAXIMUM: 25 TO 75 )"
```

```
1110  INPUT Y
1210  IF Y < 25 OR Y > 70 THEN
          1410
1310  GOTO 1610
1410  PRINT "TRY AGIAN AND WATCH YOUR LIMITS"
1510  GOTO 910
1610  LET K = 0
1710  LET R = 57.3
1810  LET X1 = X / R
1910  LET Y1 = Y / R
2010  INPUT "INDEX OF REFRACTION OF FIRST MEDIUM:  ";L
2110  LET N = L *  SIN (X1) /  SIN (Y1)
2210  LET N = N * 910:
      LET N =  INT (N):
      LET N = N / 100
2310  PRINT
2410  PRINT "INCIDENT ANGLE =";X;" REFRACTION ANGLE = ";N
2510  PRINT
2610  PRINT "INDEX OF REFRACTION FOR 2ND MEDIUM= ";N
2710  PRINT
2810  PRINT "DO YOU WISH TO SEE THE RESULTS GRAPHICALLY ? (Y/N)"
2910  INPUT M$
3010  IF M$ = "N" THEN
          5310
3110  HOME
3210  HGR
3310  HCOLOR= 5
3410  HPLOT 0,79 TO 277,79
3510  HPLOT 0,80 TO 277,80
3610  HPLOT 0,81 TO 277,81
3710  HCOLOR= 3
3810  LET A = 80 *  SIN (X1) /  COS (X1)
3910  HPLOT 1,1 TO A,80
4010  LET D = 79 *  SIN (Y1) /  COS (Y1)
4110  LET E = A + D
4210  IF E < 277 GOTO 4910
4310  LET E = 277
4410  LET D = 277 - A
4510  LET F = D *  COS (Y1) /  SIN (Y1)
4610  LET F = F + 80
4710  HPLOT A,80 TO E,F
4810  GOTO 5010
4910  HPLOT A,80 TO E,159
5010  VTAB (22)
5110  PRINT "INCIDENT ANGLE=";X;" REFRACTION ANGLE = ";Y
5210  PRINT "INDEX OF REFRACTION FOR 2ND MEDIUM = ";N
5310  END

END OF LISTING

PROGRAM LENGTH: 63 LINES / 1246 BYTES
```

RELATIVITY

This program is an explanation and set of calculations based upon the theory of relativity of Einstein. General information about the theory, the concept of rest mass and relativistic mass is provided.

Data Input

(a) request for information

(b) choice of problem to be done:

(1) time travel near the speed of light

(2) energy output using $E=mc^2$

(3) mass increase near the speed of light

Results Received

(a) various computations per viewers choice

(b) a comparison to ones friends left behind on earth during the viewers time travel

```
 10  HOME
110  HTAB 10:
     PRINT "EINSTEIN'S THEORY OF"
210  VTAB 4:
     HTAB 10:
     PRINT "     RELATIVITY
310  VTAB 6:
     HTAB 10:
     PRINT "          BY"
410  VTAB 10:
     HTAB 10:
     PRINT "DR. MARCELLINE BARRON"
510  VTAB 12:
     HTAB 10:
     PRINT "          AND"
610  VTAB 14:
     HTAB 10:
     PRINT "  LEONARD F. REUTER"
```

```
 710  VTAB 20:
      PRINT "PRESS SPACE BAR TO CONTINUE";:
      GET S$
 810  HOME
 910  INVERSE
1010  HTAB 14
1110  PRINT "INFORMATION"
1210  NORMAL
1310  PRINT :
      PRINT
1410  PRINT "WHEN AN OBJECT IS AT REST WITH RESPECT":
      PRINT :
      PRINT "TO THE OBSERVER AND THE OBSERVER'S":
      PRINT :
      PRINT "MEASURING INSTRUMENTS,THE MASS OF ":
      PRINT :
      PRINT "OBJECT IS SAID TO BE THE":
      PRINT :
      PRINT
1510  FLASH
1610  PRINT "REST MASS"
1710  NORMAL
1810  VTAB 20:
      PRINT "PRESS ANY KEY TO CONTINUE ";:
      GET S$
1910  IF F$ = " " THEN
          2010
2010  HOME
2110  INVERSE
2210  HTAB 14:
      PRINT "INFORMATION"
2310  NORMAL
2410  PRINT :
      PRINT
2510  VTAB 5:
      PRINT "WHEN THE OBJECT IS MOVING, IT'S MASS":
      PRINT :
      PRINT
2610  PRINT "INCREASES. THIS NEW MASS, WHICH":

      PRINT :
      PRINT
2710  PRINT "INCREASES RAPIDLY AS THE OBJECT":
      PRINT :
      PRINT
2810  PRINT "APPROACHES THE SPEED OF LIGHT,IS CALLED":
      PRINT :
      PRINT
2910  FLASH :
      PRINT "THE RELATIVISTIC MASS":
      PRINT :
      PRINT
2915  NORMAL
```

```
3010  PRINT "BECAUSE IT IS IN KEEPING WITH EINSTEINS":
      PRINT :
      PRINT
3110  PRINT "THEORY OF RELATIVITY."
3115  GET S$
3210  LET C = 299792.5
3310  LET D = C ^ 2
3410  LET V = .999 * C
3510  LET X = ( SQR (1 - (V ^ 2 / D)))
3610  HOME
3710  PRINT "WOULD YOU LIKE TO SEE EINSTEIN'S THEORY":
      PRINT :
      PRINT
3810  PRINT "SPECIAL RELATIVITY DEMONSTRATED IN....."
3815  PRINT "---------------------------------------":
      PRINT :
      PRINT
3910  PRINT "1)TIME TRAVEL NEAR THE SPEED OF LIGHT":
      PRINT :
      PRINT
4010  PRINT "2)ENERGY OUTPUT (E=MC^2)":
      PRINT :
      PRINT
4110  PRINT "3)MASS INCREASE NEAR THE SPEED OF LIGHT"
4210  VTAB 17
4310  INPUT A
4410  IF A > 3 THEN
          4810
4510  REM  PUT GOSUB EXPLANATION HERE
4610  HOME
4710  ON A GOTO 5010,6010,6810
4810  PRINT "INPUT 1,2, OR 3 ONLY...";
4910  GOTO 4310
5010  PRINT "INPUT A DISTANCE IN KILOMETERS AND I'LL":
      PRINT :
      PRINT "SHOW YOU THE TIME IT TAKES TO TRAVEL":
      PRINT :
      PRINT "THAT DISTANCE AT 99.9% OF THE":
      PRINT :
      PRINT "SPEED OF LIGHT (ONLY PHOTONS TRAVEL AT":
      PRINT :
      PRINT "THE SPEED OF LIGHT) RELATIVE TO":
      PRINT :
      PRINT "YOU AND RELATIVE TO A FRIEND
5011  :

      PRINT :
      PRINT "LEFT BEHIND ON EARTH.":
      PRINT :
      PRINT
5210  PRINT "HOW FAR WOULD YOU LIKE TO GO":
      PRINT :
```

```
5211  PRINT "      (IN KILOMETERS)"
5310  INPUT L
5410  PRINT "
                          "
5510  LET T = L / V
5610  LET T1 = T / X
5709  HOME
5710  PRINT "YOU HAVE TRAVELED ";L;" KILOMETERS IN":
      PRINT
5711  :
      PRINT "        ";T;"                              ":
      PRINT :
      PRINT
5712  :
      PRINT "SECONDS. YOUR FRIEND WHOM YOU DECIDED":
      PRINT :
      PRINT "TO LEAVE BEHIND IS DEAD.HE DID":
      PRINT :
      PRINT "LEAVE A COMPUTER AND IT SAYS IT":
      PRINT :
      PRINT "TOOK YOU ";T;" SECONDS TO RETURN":
      PRINT
5910  GOTO 7410
6010  PRINT "GIVE ME A MASS IN GRAMS AND I'LL SHOW":
      PRINT :
      PRINT "YOU THE AMOUNT OF ENERGY RELEASED":
      PRINT :
      PRINT "IN TERMS OF NEWTONS LIFTED AND HOW":
      PRINT :
      PRINT "HIGH IN KILOMETERS IN A ZERO":
      PRINT :
      PRINT "GRAVITY (FRICTIONLESS) SYSTEM,WHEN":
      PRINT :
      PRINT "ACCELERATED TO 99.9% OF THE SPEED":
      PRINT
6011  PRINT "OF LIGHT."
6110  INPUT N
6210  :
      PRINT :
      PRINT "GRAMS.":
      PRINT :
      PRINT
6310  LET M = N / 1E3
6410  LET E = M * D
6510  LET K = E / 1E6
6610  PRINT E;"NEWTONS, ";K;" KILO-                    METRES OFF THE GROUND."
6710  GOTO 7410
6810  PRINT "INPUT AN AMOUNT OF MASS IN GRAMS        AND I WILL SHOW YOU HOW
       MUCH THAT       MASS WILL INCREASE WHEN ITS VELOCITY    REACHES 99.9
       OF THE SPEED OF LIGHT."
6910  INPUT M1
```

```
7010  PRINT "  GRAMS"
7110  LET M2 = M1 / X
7210  PRINT "THE OBJECT HAS INCREASED FROM THE ORIGINAL ";M1;"GRAMS TO
       A NEW SUM OF   ";M2;" GRAMS"
7310  GOTO 7410
7410  VTAB 20:
      PRINT "WOULD YOU LIKE TO SEE ANOTHER":
      PRINT "DEMONSTRATION ?";
7510  INPUT A$
7610  IF A$ = "Y" THEN
          3610
7710  HOME
7810  PRINT "BYE, BYE";""
7910  FOR S = 1 TO 255
8010  NEXT S
8110  HOME
8210  END


  END OF LISTING

  PROGRAM LENGTH: 90 LINES / 2972 BYTES
```

ROTATIONAL INERTIA EQ/CALC.

This is a program designed to acquaint the user with some sample equations for the rotational inertia (or moment of inertia) of six different sample solids. The program also calculates the rotational inertia of any of these solids. The formulas given are for the following solids: sphere, thin ring, thick ring, cylinder, disc (rotated two ways), and thin rod (rotated two ways). Instructional information about rotational inertia is also available.

Data Input

(a) choice of solid

(b) mass of solid

(c) radius or length of solid

Results Returned

Calculated rotational inertia of the solid of your choice

```
10  HOME
11  REM  TITLE PAGE
12  INVERSE
13  HTAB 3
15  PRINT "ROTATIONAL INERTIA CALC.&EQ.&INFO."
16  NORMAL
18  PRINT :
    PRINT :
    PRINT :
    PRINT :
    PRINT
20  PRINT "             WRITTEN BY  "
22  PRINT
24  PRINT "      DR. MARCELLINE A. BARRON  "
26  PRINT
28  PRINT "                AND  "
30  PRINT
32  PRINT "         SCOTT D. SCHAFER "
```

```
  34  PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT
  36  PRINT "PRESS ANY KEY TO CONTINUE.....":
      GET A$
 100  HOME
 200  INVERSE
 300  PRINT "    EQUATIONS FOR ROTATIONAL MOTION    "
 400  NORMAL
 600  PRINT "1)THIN RING EQ."
 700  PRINT :

 800  PRINT "2)THICK RING EQ."
 900  PRINT
1000  PRINT "3)DISC EQ. (ROTATE CENT.)"
1100  PRINT
1200  PRINT "4)DISC EQ. (ROTATE END)"
1300  PRINT
1400  PRINT "5)UNIFORM THIN ROD (ROT. CENT.)"
1500  PRINT
1600  PRINT "6)UNIFORM THIN ROD (ROT. END)"
1700  PRINT
1800  PRINT "7)CYLINDER EQ."
1900  PRINT
2000  PRINT "8)SOLID BALL EQ."
2010  PRINT
2050  PRINT "9)EXIT PROGRAM"
2085  PRINT
2090  PRINT "10)CALCULATIONS"
2100  PRINT
2150  PRINT "11)INFORMATION"
2155  PRINT
2200  INPUT "WHICH WOULD YOU LIKE?";A
2300  HOME
2400  IF A = 1 GOTO 3200
2500  IF A = 2 GOTO 5300
2600  IF A = 3 GOTO 3900
2700  IF A = 4 GOTO 8400
2800  IF A = 5 GOTO 6800
2900  IF A = 6 GOTO 7600
3000  IF A = 7 GOTO 4600
3100  IF A = 8 GOTO 6000
3150  IF A = 9 THEN
          9500
3160  IF A = 10 GOTO 9600
3166  IF A = 11 THEN
          21500
```

```
3200  PRINT "INERTIA = MR^2"
3300  PRINT :
      PRINT
3400  INPUT "READY?(Y/N)";A$
3500  HOME
3600  IF  LEFT$ (A$,1) = "N" GOTO 3200
3700  GOSUB 8900
3800  GOTO 100
3900  PRINT "INERTIA = 1/2MR^2"
4000  PRINT :
      PRINT
4100  INPUT "READY?(Y/N)";B$
4200  HOME
4300  IF  LEFT$ (B$,1) = "N" GOTO 3900
4400  GOSUB 8900
4500  GOTO 100
4600  PRINT "INERTIA = 1/2MR^2"
4700  PRINT :
      PRINT
4800  INPUT "READY?(Y/N)";C$
4900  HOME
5000  IF  LEFT$ (C$,1) = "N" GOTO 4600
5100  GOSUB 8900
5200  GOTO 100
5300  PRINT "INERTIA = 1/2M(R^1+R^2)"
5400  PRINT :
      PRINT
5500  INPUT "READY?(Y/N)";D$
5600  HOME
5700  IF  LEFT$ (D$,1) = "N" GOTO 5300
5800  GOSUB 8900
5900  GOTO 100
6000  PRINT "INERTIA = 2/5MR^2"
6100  PRINT :
      PRINT
6200  INPUT "READY?(Y/N)";E$
6300  HOME
6400  IF  LEFT$ (E$,1) = "N" GOTO 6000
6500  GOSUB 8900
6600  HOME
6700  GOTO 100
6800  PRINT "INERTIA = 1/12ML^2"
6900  PRINT :
      PRINT
7000  INPUT "READY?(Y/N)";F$
7100  HOME
7200  IF  LEFT$ (F$,1) = "N" GOTO 6800
7300  GOSUB 8900
7400  HOME
7500  GOTO 100
```

```
 7600  PRINT "INERTIA = 1/3ML^2"
 7700  PRINT :
       PRINT
 7800  INPUT "READY?(Y/N)";G$
 7900  HOME
 8000  IF  LEFT$ (G$,1) = "N" GOTO 7600
 8100  GOSUB 8900
 8200  HOME
 8300  GOTO 100
 8400  PRINT "INERTIA = 1/4MR^2"
 8500  PRINT :
       PRINT
 8600  INPUT "READY?(Y/N)";H$
 8700  HOME
 8800  IF H$ = "N" GOTO 8400
 8900  PRINT " IF YOU WISH TO EXIT THIS PROGRAM"
 9000  PRINT " TYPE IN A (Y)"
 9100  INPUT X$
 9200  IF X$ = "Y" GOTO 9400
 9300  GOTO 100
 9400  HOME
 9500  HTAB 14:
       VTAB 13:
       PRINT "GOODBYE....."
 9510  VTAB 20
 9515  PRINT "PRESS ANY KEY......":
       GET F$
 9520  IF F$ = " " THEN
           9550
 9545  HOME
 9550  END
 9600  HOME
 9700  INVERSE
 9800  HTAB 5:
       PRINT "WHICH EQUATION DO YOU WISH TO USE"
 9900  NORMAL
10000  PRINT :
       PRINT
10100  PRINT "1)THIN RING EQ."
10200  PRINT
10300  PRINT "2)THICK RING EQ."
10350  PRINT
10400  PRINT "3)DISC (ROT. CENT.)"
10450  PRINT
10500  PRINT "4)DISC (ROT. SIDE)"
10550  PRINT
10600  PRINT "5)UNIFORM THIN ROD(ROT. CENT.)"
10650  PRINT
10700  PRINT "6)UNIFORM THIN ROD(ROT. END)"
10750  PRINT
10800  PRINT "7)CYLINDER"
10850  PRINT
10900  PRINT "8)SOLID BALL"
```

```
10930  PRINT
10940  PRINT "9)EXIT PROGRAM"
10950  PRINT :
       PRINT
11000  INPUT "WHICH DO YOU WISH TO USE?";B
11050  HOME
11100  IF B = 1 THEN
           12000
11200  IF B = 2 THEN
           14500
11300  IF B = 3 THEN
           12600
11400  IF B = 4 THEN
           15400
11500  IF B = 5 THEN
           16650
11600  IF B = 6 THEN
           18200
11700  IF B = 7 THEN
           13600
11800  IF B = 8 THEN
           19900
11900  IF B = 9 THEN
           9500
11950  HOME
12000  PRINT "THIS IS THE EQUATION- I=M*R^2"
12010  PRINT :
       PRINT
12020  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN (Y/N) ?";RX$
12025  PRINT :
       PRINT
12030  IF RX$ = "N" THEN
           11950
12100  INPUT "MASS ?";C
12150  PRINT
12160  INPUT "RADIUS ?";D
12200  LET E = C * D ^ 2
12250  PRINT :
       PRINT
12300  PRINT "INERTIA= ";E
12350  PRINT :
       PRINT
12400  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
12450  INPUT "USEING THIS EQUATION (Y/N)?";ZX$
12460  IF ZX$ = "Y" THEN
           12100
12500  GOTO 9600
12550  HOME
12600  PRINT "THIS IS THE EQUATION-I=1/2M*R^2"
12650  PRINT :
       PRINT
12700  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN (Y/N)?";RZ$
12750  PRINT :
       PRINT
```

```
12760  HOME
12800  IF RZ$ = "N" THEN
           12550
12850  PRINT :
       PRINT
12900  INPUT "MASS ?";F
12950  PRINT
13000  INPUT "RADIUS ?";G
13050  PRINT
13100  LET H = .5 * F * G ^ 2
13200  PRINT "INERTIA=";H
13250  PRINT :
       PRINT
13300  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
13400  INPUT "USING THIS EQUATION(Y/N)?";YT$
13450  IF YT$ = "Y" THEN
           12900
13500  GOTO 9600
13550  HOME
13600  PRINT "THIS IS THE EQUATION-I=1/2MR^2 "
13640  PRINT :
       PRINT
13650  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN(Y/N)";AB$
13700  PRINT :
       PRINT
13750  IF AB$ = "N" THEN
           13550
13800  INPUT "MASS ?";T
13850  PRINT
13900  INPUT "RADIUS ?";Y
13950  PRINT
14000  LET W = .5 * T * Y ^ 2
14150  PRINT "INERTIA=";W
14200  PRINT :
       PRINT
14250  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
14300  INPUT "USING THIS EQUATION(Y/N)?";GH$
14350  IF GH$ = "Y" THEN
           13800
14400  GOTO 9600
14450  HOME
14500  PRINT "THIS IS THE EQUATION-I=1/2*M(R1^2+R2^2)"
14600  PRINT :
       PRINT
14650  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN(Y/N)?";CD$
14700  HOME
14750  IF CD$ = "N" THEN
           14450
14800  INPUT "MASS ?";I
14850  PRINT
14900  INPUT "RADIUS 1?";O1
14930  PRINT
```

```
14940  INPUT "RADIUS 2?";O2
14950  PRINT :
       PRINT
15000  LET P = .5 * I * (O1 ^ 2 + O2 ^ 2)
15100  PRINT "INERTIA= ";P
15150  PRINT "DO YOU HAVE ANY MORE CALCULATIONS "
15200  INPUT "USING THIS EQUATION(Y/N)?";WE$
15250  IF WE$ = "Y" THEN
           14800
15300  GOTO 9600
15350  HOME
15400  PRINT "THIS IS THE EQUATION- I=1/4 *M*R^2"
15500  PRINT :
       PRINT
15600  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN (Y/N) ?";TP$
15650  PRINT :
       PRINT
15700  IF TP$ = "N" THEN
           15350
15800  INPUT "MASS ?";K
15900  PRINT
16000  INPUT "RADIUS ?";P
16100  LET I = .25 * K * P ^ 2
16150  PRINT :
       PRINT
16200  PRINT "INERTIA =";I
16250  PRINT :
       PRINT
16300  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
16400  INPUT "USING THIS EQUATION ?(Y/N)";C$
16500  IF C$ = "Y" THEN
           15800
16600  GOTO 9600
16650  HOME
16700  PRINT "THIS IS THE EQUATION-I=1/12*M*L^2"
16750  PRINT :
       PRINT
16800  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN (Y/N) ?";LO$
16850  PRINT :
       PRINT
16900  IF LO$ = "N" THEN
           16650
17000  INPUT "MASS ?";D
17100  PRINT :
       PRINT
17200  INPUT "LENGTH ?";L
17300  LET I = .08333333 * D * L ^ 2
17350  PRINT :
       PRINT
17400  PRINT "INERTIA =";I
17500  PRINT :
       PRINT
17600  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
17700  INPUT "USING THIS EQUATION ?(Y/N)";ZIP$
```

```
17800  PRINT :
       PRINT
17900  IF ZIP$ = "Y" THEN
           17000
18000  GOTO 9600
18100  HOME
18200  PRINT "THIS IS THE EQUATION-I=1/3*M*L^2"
18300  PRINT :
       PRINT
18400  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN(Y/N)?";K$
18500  PRINT :
       PRINT
18600  IF K$ = "N" THEN
           18100
18700  INPUT "MASS ?";J
18800  PRINT :
       PRINT
18900  INPUT "LENGTH ?";S
19000  PRINT :
       PRINT
19100  LET I = .33333333 * J * S ^ 2
19200  PRINT "INERTIA =";I
19300  PRINT :
       PRINT
19400  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
19500  INPUT "USING THIS EQUATION(Y/N) ?";THUD$
19600  IF THUD$ = "Y" THEN
           18700
19700  GOTO 9600
19800  HOME
19900  PRINT "THIS IS THE EQUATION-I=2/5*M*R^2"
20000  PRINT :
       PRINT
20100  INPUT "ARE YOU READY FOR THE CALCULATIONS TO BEGIN(Y/N) ?";  T$
20200  PRINT :
       PRINT
20300  IF SHIT$ = "N" THEN
           19800
20350  HOME
20400  INPUT "MASS ?";M
20500  PRINT :
       PRINT
20600  INPUT "RADIUS ?";R
20700  PRINT :
       PRINT
20800  LET I = .4 * M * R ^ 2
20900  PRINT "INERTIA =";I
21000  PRINT :
       PRINT
21100  PRINT "DO YOU HAVE ANY MORE CALCULATIONS"
21200  INPUT "USING THIS EQUATION(Y/N) ?";P$
21300  IF P$ = "Y" THEN
           20200
21400  GOTO 9600
```

```
21500  HOME
21600  INVERSE
21650  HTAB 14
21700  PRINT "INFORMATION"
21800  NORMAL
21850  PRINT :
       PRINT :
       PRINT :
       PRINT :
       PRINT
21900  PRINT "ROTARY MOTION - IS THE MOTION OF A BODY":
       PRINT
21910  PRINT "ABOUT AN AXIS."
21950  VTAB 20
22000  INPUT "PRESS RETURN TO CONTINUE";H$
22100  IF H$ = " " THEN
           22200
22200  HOME
22210  INVERSE
22220  HTAB 14
22230  PRINT "INFORMATION"
22240  NORMAL
22300  PRINT :
       PRINT
22400  PRINT "IF WE WISH TO CHANGE THE RATE":
       PRINT :
       PRINT "OF ROTATION OF AN OBJECT ABOUT AN AXIS"
22500  PRINT :
       PRINT "THAT IS, CHANGE ITS ANGULAR VELOCITY,":
       PRINT :
       PRINT "WE MUST APPLY A TORQUE ABOUT THE AXIS."
22550  VTAB 20
22600  INPUT "PRESS RETURN TO CONTINUE";H$
22700  IF H$ = " " THEN
           22800
22800  HOME
22810  INVERSE
22820  HTAB 14
22830  PRINT "INFORMATION"
22840  NORMAL
22850  PRINT :
       PRINT
22860  PRINT "THE ROTATIONAL INERTIA IN ROTARY MOTION":
       PRINT :
       PRINT "TAKES INTO ACCOUNT BOTH THE SHAPE":
       PRINT :
       PRINT "AND THE MASS OF THE ROTATING OBJECT."
22870  VTAB 20
22880  INPUT "PRESS RETURN TO CONTINUE";H$
22890  IF H$ = " " THEN
           22895
22895  HOME
22900  INVERSE
23000  HTAB 14
```

```
23100   PRINT "INFORMATION"
23200   NORMAL
23300   PRINT :
        PRINT
23400   PRINT "ROTATIONAL INERTIA HAS THE UNIT":
        PRINT :
        PRINT "DIMENSIONS  KG M^2
23500   VTAB 20
23600   INPUT "PRESS RETURN TO GO BACK TO THE MENU";H$
23700   IF H$ = " " THEN
            23800
23800   GOTO 100


END OF LISTING

PROGRAM LENGTH: 342 LINES / 6205 BYTES
```

TEMPERATURE CONVERSIONS

This program is one in high resolution graphics that attempts to help the student understand the relationships between the Fahrenheit, Celsius, and Kelvin temperature scales by showing the boiling point of water, the freezing point of water, and absolute zero on all three scales. Also it will compute any conversion between any two of these three scales.

```
 400  CALL  - 936
 500  TEXT
 600  HOME
 700  INVERSE
 800  HTAB 10:
      VTAB 5:
      PRINT "TEMPERATURE CONVERSIONS"
 900  NORMAL
1000  HTAB 10:
      VTAB 10:
      PRINT "          BY"
1100  HTAB 10:
      VTAB 12:
      PRINT "   DAVID W. SCHAIBLE"
1200  HTAB 15:
      VTAB 14:
      PRINT "    AND"
1300  HTAB 10:
      VTAB 16:
      PRINT "  DR. MARCELLINE BARRON"
1400  HTAB 15:
      VTAB 18:
      PRINT "    1982"
1500  FOR X = 1 TO 5000:
      NEXT
1600  TEXT
1700  HOME
1800  HTAB 18:
      INVERSE :
      PRINT "MENU":
      NORMAL
1900  PRINT "---------------------------------------"
2000  VTAB 5:
      PRINT "1) DEGREES F TO DEGREES C":
      PRINT :
      PRINT "2) DEGREES C TO DEGREES F":
      PRINT :
      PRINT "3) DEGREES F TO DEGREES K":
      PRINT :
      PRINT "4) DEGREES K TO DEGREES F":
      PRINT :
```

```
      PRINT "5) DEGREES C TO DEGREES K":
      PRINT :
      PRINT "6) DEGREES K TO DEGREES C"
2100  PRINT :
      PRINT "7) BOILING / WATER
2200  PRINT :
      PRINT "8) FREEZING / WATER
2300  :
      PRINT :
      PRINT "9)ABSOLUTE ZERO"
2400  PRINT :
      PRINT :
      INPUT "MAKE ONE SELECTION";A
2500  IF A = 1 GOTO 3400
2600  IF A = 2 GOTO 4300
2700  IF A = 3 GOTO 5500
2800  IF A = 4 GOTO 6300
2900  IF A = 5 GOTO 7100
3000  IF A = 6 GOTO 7800
3100  IF A = 7 GOTO 5000
3200  IF A = 8 GOTO 5300
3300  IF A = 9 GOTO 5400
3400  HOME
3500  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES F ";A$
3600  IF A$ = "" THEN
          3400
3610  VTAB 10:
      HTAB 15:
      PRINT "C = (F - 32) * 5/9"
3700  LET A =  VAL (A$)
3800  LET B = (A - 32) * 5 / 9
3900  VTAB 15:
      HTAB 15:
      PRINT "DEGREES C = ";B
4000  VTAB 22:
      INPUT "WOULD YOU LIKE ANOTHER CONVERSION (Y/N)";X$
4100  IF X$ = "Y" THEN
          GOTO 1700
4200  IF X$ = "N" THEN
          GOTO 1600
4300  HOME
4400  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES C ";V$
4500  IF V$ = "" THEN
          4400
4550  VTAB 10:
      HTAB 15:
      PRINT "F = (9 / 5 * C) + 32"
```

```
4600  LET V =  VAL (V$)
4700  LET Z = (9 / 5 * V) + 32
4800  VTAB 15:
      HTAB 15:
      PRINT "DEGREES F = ";Z
4900  GOTO 4000
5000  LET D$ =  CHR$ (4)
5100  HGR
5200  PRINT D$;"BLOAD TEMP/GRFX-1"
5210  FOR X = 1 TO 10000:
      NEXT
5220  GOTO 1600
5300  HGR
5305  PRINT D$;"BLOAD TEMP/GRFX-2"
5310  FOR X = 1 TO 10000:
      NEXT
5320  GOTO 1600
5400  HGR
5405  PRINT D$;"BLOAD TEMP/GRFX-3"
5410  FOR X = 1 TO 10000:
      NEXT
5420  GOTO 1600
5500  HOME

5600  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES F ";J$
5700  IF J$ = "" THEN
          5600
5750  VTAB 10:
      HTAB 15:
      PRINT " K = (F - 32) * 5/9 = C":
      PRINT :
      PRINT "    K = C + 273"
5800  LET J =  VAL (J$)
5900  LET K = (J - 32) * 5 / 9
6000  LET Q = K + 273
6100  PRINT "DEGREES K = ";Q
6200  GOTO 4000
6300  HOME
6400  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES K ";L$
6500  IF L$ = "" THEN
          6400
6600  LET L =  VAL (L$)
6700  LET K = L - 273
6800  LET F = (9 / 5 * K) + 32
6900  PRINT "DEGREES F = ";F
7000  GOTO 4000
7100  HOME
7200  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES C ";Q$
```

```
7300  IF Q$ = "" THEN
          7200
7400  LET Q =  VAL (Q$)
7500  LET W = Q + 273
7600  PRINT "DEGREES K = ";W
7700  GOTO 4000
7800  HOME
7900  VTAB 5:
      HTAB 15:
      INPUT "ENTER DEGREES K ";Z$
8000  IF Z$ = "" THEN
          7900
8100  LET Z =  VAL (Z$)
8200  LET X = Z - 273
8300  PRINT "DEGREES C = ";X
8400  GOTO 4000
8500  HOME
8600  FOR S = 1 TO 255
8700  NEXT S


END OF LISTING

PROGRAM LENGTH: 95 LINES / 1911 BYTES
```

TIMER

Timer is a program that records time in seconds, minutes and hours. The timer in the program can be set up to count any amount of time up to 1000 hours.

```
 10  HOME
 20  PRINT  TAB( 14)"DIGITAL TIMER"
 30  PRINT
 40  PRINT  TAB( 19)"FOR"
 50  PRINT
 60  PRINT  TAB( 16)"APPLE II"
 70  VTAB 20:
     INPUT "PRESS <RETURN> TO START ====>";T$
 80  GOSUB 450
 90  PRINT  TAB( 14)"DIGITAL TIMER"
100  VTAB 17
110  PRINT
120  PRINT "PRESS 'CTRL C' TO STOP"
130  PRINT
140  PRINT "PRESS 'CTRL S' TO PAUSE"
150  PRINT
160  PRINT "ENTER 'STOP' TO EXIT
170  VTAB 24
180  INPUT "PRESS <RETURN> TO START ====>";A$
190  IF A$ = "STOP" THEN
          210
200  GOTO 220
210  LET D$ =  CHR$ (4):
     PRINT D$;"RUN HELLO-1"
220  LET W = 0
230  LET T = 1000
240  LET X = 0:
     LET Y = 0:
     LET Z = 0
250  HOME
260  PRINT  TAB( 18)"TIMER"
265  HTAB 9
270  VTAB 4:
     PRINT "HRS ";Z(1);" : MIN ";Y(1);" : SEC ";X(1)
271  VTAB 12
275  INVERSE
280  HTAB 9:
     PRINT "HRS ";Z;" : MIN ";Y;" : SEC ";X:
     NORMAL
290  GOSUB 370
300  LET X = X + 1
310  IF X = 60 THEN
          330
320  GOTO 265
330  LET X = 0
340  LET Y = Y + 1
```

```
350  IF Y = 60 THEN
         410
360  GOTO 250
370  IF Z = Z(1) AND Y = Y(1) AND X = X(1) THEN
         GOTO 590
380  FOR A = 1 TO 618
390  NEXT A
400  RETURN
410  LET Y = 0
420  LET Z = Z + 1
430  IF Z = T THEN

         240
440  GOTO 250
450  HOME :
     PRINT " HOW LONG SHOULD THE TIMER BE SET FOR?"
460  PRINT
470  PRINT  TAB( 14)"(HRS/MIN/SEC)"
480  VTAB 6
490  INPUT "HOURS:?";Z(1)
500  INPUT "MINUTES:?";Y(1)
510  INPUT "SECONDS:?";X(1)
520  HOME
530  PRINT "HRS ";Z(1);" : MIN ";Y(1);" : SEC ";X(1)
540  PRINT :
     INPUT "ARE THEY CORRECT?";Q$
550  IF Q$ = "NO" OR Q$ = "N" THEN
         450
560  IF Z(1) = 0 AND Y(1) = 0 AND X(1) = 0 THEN
         450
570  HOME
580  RETURN
590  HOME
600  PRINT "****************************************"
610  VTAB 11:
     PRINT  TAB( 13)"T I M E S   U P "
620  VTAB 20:
     PRINT "****************************************"
630  PRINT "                                        "
640  FOR I = 1 TO 3000:
     NEXT
650  GOTO 10


END OF LISTING

PROGRAM LENGTH: 68 LINES / 1241 BYTES
```

VECTOR ADDITION

This program graphically adds two vectors, both originating at the origin in the x-y plane.

Data Input

(a) length of first vector

(b) angle of first vector from positive x-axis

(c) length of second vector

(d) angle of second vector from psoitive x-axis

Results Returned

(a) length of resultant

(b) angle of resultant from positive x-axis (0-360 degress)

(c) graphical display of the original vectors and the resultant

Limitations:

The origin is located at (140,80). The vectors should not exceed the limits of the graph--x components not more than 140, y components not more than 80 (this includes the sum of the x components and the sum of the y components).

```
 1  REM  VECTOR ADDITION
 2  REM  REVISED BY J KRUSLING
10  TEXT :
    HOME :
    CLEAR
20  HTAB (12):
    INVERSE :
    PRINT "VECTOR ADDITION":
    NORMAL
40  INPUT "NUMBER OF VECTORS TO BE ADDED (2-4) ";N:
    IF N < 2 OR N > 4 THEN
        10
45  PRINT :
    PRINT "VECTOR LENGTHS SHOULD BE BETWEEN 10 & 50";:
    PRINT
50  FOR C = 1 TO N
55      PRINT
60      PRINT "VECTOR F"C" LENGTH";:
        INPUT F(C)
70      PRINT "ANGLE F"C" FROM X-AXIS";:
        INPUT A(C)
```

```
 80      PRINT
 90  NEXT C
100  FOR C = 1 TO N
110      LET A(C) = A(C) / 57.3
120      LET X(C) = F(C) *  COS (A(C))
130      LET Y(C) = F(C) *  SIN (A(C))
140  NEXT C
150  FOR C = 1 TO N
160      LET SX = SX + X(C)
170      LET SY = SY + Y(C)
180  NEXT C
190  LET RF =  SQR (SX ^ 2 + SY ^ 2)
200  LET AR = SY / SX
210  LET RA =  ATN (AR)
220  LET RA = RA * 57.3:
     HOME
230  HGR
240  HCOLOR= 1
250  HPLOT 0,80 TO 270,80
260  HPLOT 135,0 TO 135,159
270  HCOLOR= 3
280  HPLOT 135,80 TO 135 + X(1),80 - Y(1)
285  HCOLOR= 7
290  HPLOT 135 + X(1),80 - Y(1) TO 135 + X(1) + X(2),80 - Y(1) - Y(2)
295  HCOLOR= 5
300  HPLOT 135 + X(1) + X(2),80 - Y(1) - Y(2) TO 135 + X(1) + X(2) + X(3),8
     0 - Y(1) - Y(2) - Y(3)
302  IF N = 3 THEN
         320
305  HCOLOR= 6
310  HPLOT 135 + X(1) + X(2) + X(3),80 - Y(1) - Y(2) - Y(3) TO 135 + X(1)
      + X(2) + X(3) + X(4),80 - Y(1) - Y(2) - Y(3) - Y(4)
320  HCOLOR= 2
330  HPLOT 135,80 TO 135 + SX,80 - SY
340  VTAB (22)
341  LET RF = RF * 100:

     LET RF =  INT (RF):
     LET RF = RF / 100
342  LET RA = RA * 100:
     LET RA =  INT (RA):
     LET RA = RA / 100
343  IF SX < 0 AND SY > 0 THEN
         LET RA = RA + 180
344  IF SX < 0 AND SY < 0 THEN
         LET RA = RA + 180
345  IF SX > 0 AND SY < 0 THEN
         LET RA = RA + 360
346  VTAB (22)
350  PRINT "R INTEGER INTO LANGUAGE CARD)"
350  PRINT "BLOAD INTBASIC,A$D000"
360  REM  --WRITE PROTECT THE CARD
370  LET A =  PEEK ( - 16254):
     REM   $C082
```

```
  375  PRINT :
       PRINT :
       PRINT *  376 EMBEDDED MACHINE CODE
  376  PRINT  CHR$ (4);"CAR II*59322 EMBEDDED MACHINE CODE
59322  (4)"BRUNTHE COMPARER II*18761 EMBEDDED MACHINE CODE
18761  *12745 EMBEDDED MACHINE CODE
12745  28:
       RETURN *21544 EMBEDDED MACHINE CODE
21544  ):
       VTAB NH(T) - 10:
       PRINT :
       FOR X = 1 TO 3:
           HTAB (TB(T) - 9 + 2 * X):
           PRINT "::":
       NEXT :
       HTAB (TB(T) - 3):
       PRINT "::::":
       HTAB (TB(T) - 3):
       PRINT "::::":
       PRINT  RIGHT$ (T1$,TB(T) + 1):
       PRINT  RIGHT$ (T2$,TB(T) + 1):
       HTAB (TB(T) - 3):
       PRINT "::::":
       HTAB (TB(T) - 3)*13352 EMBEDDED MACHINE CODE
13352  ):
       FOR X = 1 TO 100:
      NEXT X,N*65280 EMBEDDED MACHINE CODE
65280  *65280 EMBEDDED MACHINE CODE
65280


 END OF LISTING

 PROGRAM LENGTH: 60 LINES / 2539 BYTES
```

VELOCITY

The velocity program is a simple one which requires data input in the following ways:

a. number of trials

b. distance in meters

c. time in seconds

The output will be the velocity in meters/sec and the average velocity for the number of trials indicated.

```
10  REM  VELOCITY PROG
12  GOSUB 100
13  HOME
14  LET D = 0:
    LET T = 0:
    LET SV = 0
20  INPUT "NUMBER OF TRIALS";A
25  FOR C = 1 TO A
26      HOME :
        PRINT  TAB( 15)"TRIAL  ";C
27      PRINT :
        INPUT "DISTANCE (METERS) ";D
28      IF D < 0 THEN
            26
30      VTAB (8):
        INPUT "TIME (SECONDS) ";T
32      IF T <  = 0 THEN
            30
35      LET V = D / T
37      LET V = V * 1000:
        LET V =  INT (V):
        LET V = V / 1000
40      LET SV = SV + V
45      VTAB (12):
        PRINT "VELOCITY=";V;" METERS/SEC."
50      VTAB (22):
        PRINT  TAB( 7)"PRESS ANY KEY TO CONTINUE";
55      GET A$:
        IF A$ = "" THEN
            55
60  NEXT C
62  HOME :
    INPUT "WOULD YOU LIKE THE AVERAGE VELOCITY";A$
65  IF A$ = "NO" THEN
        82
67  HOME
```

```
 70  LET AV = SV / A
 72  LET AV = AV * 1000:
     LET AV =  INT (AV):
     LET AV = AV / 1000
 75  PRINT "AVG. VELOCITY=";AV;" METERS/ SEC."
 77  VTAB (22):
     PRINT  TAB( 7)"PRESS ANY KEY TO CONTINUE";
 80  GET B$:
     IF B$ = "" THEN
         80
 82  HOME :
     INPUT "WOULD YOU LIKE TO DO ANY MORE TRIALS";C$
 85  IF C$ = "YES" THEN
         13
 90  IF C$ = "NO" THEN
         190
 95  GOTO 82
100  HOME
105  VTAB (8):
     HTAB (16)
110  INVERSE

120  PRINT "VELOCITY"
130  NORMAL
140  PRINT :
     PRINT :
     PRINT
150  PRINT  TAB( 19)"BY"
160  PRINT :
     PRINT  TAB( 14)"JIM KRUSLING"
170  FOR X = 1 TO 5000:
     NEXT X
180  RETURN
190  HOME
200  PRINT "ADIOS AMIGO"
210  VTAB (22)
220  END


  END OF LISTING

  PROGRAM LENGTH: 44 LINES / 830 BYTES
```

WAVES

This program is a graphics simulation and display of the Superposition Principle of wave theory in physics. Simply stated this principle operates when two or more waves travel simultaneously through the same medium. When this occurs each wave proceeds independently as if no other waves were present. The resultant displacement of any particle at a given time is the vector sum of the displacements that the individual waves acting alone would give it. This graphics simulation is a program which plots two waves and the resultant wave in separate areas of the screen rather than on top of each other. The three plots are done simultaneously.

Data Input

(a) frequency of wave-1 in hertz

(b) amplitude of wave-1 in volts

(c) frequency of wave-2 in hertz

(d) amplitude of wave-2 in volts

Results Returned

(a) plot of wave-1

(b) plot of wave-2

(c) plot of resultant wave (sum of wave-1 and wave-2)

(d) print out of the original data choices under the plotted waves

Limitations

(a) frequency choices for waves 1 and 2 are from one to seventeen hertz

(b) amplitudes for waves 1 and 2 must be chosen from five to twenty volts

```
 10  TEXT :
     HOME
 20  REM   NAME: WAVES
 30  REM   WRITTEN BY:ROGER BURGESS
 40  REM   EDITED BY: TROY OWENS
 50  REM   DATE: 10-6-81
 60  REM
 70  REM  *************************
 80  ONERR  GOTO 110
 90  HOME
100  HTAB 18:
     INVERSE :
     PRINT "WAVES":
     NORMAL
110  VTAB 5
120  INPUT "ENTER FREQUENCY-1 (1-17) HERTZ? ";L1$
130  IF L1$ = "" THEN
          110
140  IF  VAL (L1$) <  = 0 OR  VAL (L1$) > 17 THEN
          110
150  ONERR  GOTO 160
160  VTAB 7
170  INPUT "ENTER AMPLITUDE-1 (5-20) VOLTS? ";A1$
180  IF A1$ = "" THEN
          160
190  IF  VAL (A1$) < 5 OR  VAL (A1$) > 20 THEN
          160
200  ONERR  GOTO 210
210  VTAB 9
220  INPUT "ENTER FREQUENCY-2 (1-17) HERTZ? ";J2$
230  IF J2$ = "" THEN
          210
240  IF  VAL (J2$) <  = 0 OR  VAL (J2$) > 17 THEN
          210
250  ONERR  GOTO 260
260  VTAB 11
270  INPUT "ENTER AMPLITUDE-2 (5-20) VOLTS? ";B2$
280  IF B2$ = "" THEN
          260
290  IF  VAL (B2$) < 5 OR  VAL (B2$) > 20 THEN
          260
300  LET L1 =  VAL (L1$):
     LET A1 =  VAL (A1$):
     LET J2 =  VAL (J2$):
     LET B2 =  VAL (B2$)
310  VTAB 23
320  PRINT "FREQUENCY-1 = ";L1;"   AMPLITUDE-1 = ";A1
330  VTAB 24
340  PRINT "FREQUENCY-2 = ";J2;"   AMPLITUDE-2 = ";B2;
350  LET LAMB = 275 / L1
360  LET WAVE = 275 / J2
370  HGR
```

```
380  HCOLOR= 3
390  HPLOT 0,20 TO 275,20
400  HPLOT 0,60 TO 275,60
410  HPLOT 0,120 TO 275,120
420  GOSUB 610
430  VTAB 21
440  HTAB 1
450  PRINT "RESULTANT"
460  FOR N = 1 TO 275
470      LET PI = 3.14159
480      LET ALPH = N * 2 * PI / LAMB
490      LET BETA = N * 2 * PI / WAVE
500      LET POT = A1 *  SIN (ALPH)
510      LET BOT = B2 *  SIN (BETA)
520      LET SUM = POT + BOT
530      HCOLOR= 1
540      HPLOT N,20 - POT
550      HCOLOR= 5
560      HPLOT N,60 - BOT
570      HCOLOR= 6
580      HPLOT N,120 - SUM
590  NEXT N
600  END
610  LET X = 5:
     LET Y = 32
620  LET X = X + 1
630  HPLOT X,Y
640  LET X = X - 2
650  LET Y = Y - 1
660  HPLOT X,Y
670  LET X = X + 1
680  HPLOT X,Y
690  LET X = X + 1
700  HPLOT X,Y
710  FOR I = 1 TO 6
720      LET Y = Y + 1
730      HPLOT X,Y
740  NEXT I
750  LET X = X - 2
760  HPLOT X,Y
770  LET X = X + 1
780  HPLOT X,Y
790  LET X = X + 2
800  HPLOT X,Y
810  LET X = X + 1
820  HPLOT X,Y
830  LET X = 5:
     LET Y = 72
840  LET Y = Y - 1
850  HPLOT X,Y
860  LET X = X + 1
870  HPLOT X,Y
880  LET X = X + 1
890  HPLOT X,Y
```

```
 900  LET X = X - 3
 910  LET Y = Y + 1
 920  HPLOT X,Y
 930  LET X = X + 4
 940  HPLOT X,Y
 950  LET Y = Y + 1
 960  HPLOT X,Y
 970  LET X = X - 1
 980  LET Y = Y + 1
 990  HPLOT X,Y
1000  LET X = X - 1
1010  HPLOT X,Y
1020  LET X = X - 1
1030  LET Y = Y + 1
1040  HPLOT X,Y
1050  LET X = X - 1
1060  LET Y = Y + 1
1070  HPLOT X,Y
1080  LET Y = Y + 1
1090  HPLOT X,Y
1100  FOR I = 1 TO 4
1110      LET X = X + 1
1120      HPLOT X,Y
1130  NEXT I
1140  RETURN
END OF LISTING

PROGRAM LENGTH: 114 LINES / 1612 BYTES
```